An Introduction to Amateur Television

BA TC

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Introduction to ATV

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Contents

Foreword

This book is intended to provide a practical introduction into the fascinating world of amateur television (ATV). The '*Principles of Television*' chapter explains television from the very basic concept of scanning, through to the more complex concept of colour encoding. If you feel that parts of this chapter are a little deep then please skip over them for now. As your knowledge of television grows, then it is hoped that you will return to this chapter and fill any gaps in your understanding.

It is not necessary to be fully conversant with every intricate part of the television waveform, before building and operating an ATV station, in particular colour encoding, but you should understand the difference between RGB and an encoded signal such as PAL. It takes longer to understand a PAL coder than it does to build one, as many single chip encoder designs are around!

The '*Setting Up Your TV Station*' chapter is designed to show you how to put together video equipment, and takes into account that you will not want to home construct every part of your station. You may want to use an existing camera that was previously dedicated to a video recorder and connect it to an ATV transmitter, or direct to a monitor. We hope that this chapter will leave you with confidence and understanding to do just that.

Other chapters are dedicated to video sources, where we will be building test pattern generators, electronic callsign generators, and vision switchers, to complement and expand your ATV station.

The 70cm chapter will show you how to build a simple converter, that will connect direct to your TV aerial socket and enable you to receive ATV signals. This chapter will also show you how to build a simple 70cm ATV transmitter using only a few transistors.

The 24cm chapter will deal with the changes necessary to use a satellite receiver for ATV reception on this band. This chapter will also cover building a purpose built 24cm receiver using a pre-assembled front end, and a 24cm television transmitter that will enable you to carry out simplex contacts and also work through any of the ATV repeaters in your area.

The 'Remote Control Modular ATV Station' chapter, details the BATC project for controlling your ATV station by means of a microprocessor based system utilising the I^2C protocol, which is a method of controlling equipment over a 2-wire bus. This comprehensive project consists of the Video Display Unit (VDU), the Central Processing Unit (CPU), a Vision Switcher, a Relay Board and a Serial Port.

The penultimate chapter deals with the use of computers in an ATV station. Computers not only make excellent video generators, but they can also be used to control an ATV repeater. We will be devoting a whole chapter to computer hardware, software, and control applications.

The final chapter deals with operating an amateur television station on the bands, both simplex and, in the case of 24cm, through repeaters, including working ATV contests.

Several Appendixes are included at the end of the book, giving details on band-plans as they affect amateur television, a U.K. repeater list and a list of BATC recommended component and equipment suppliers.

Printed Circuit boards will be available for many of the projects in this book. Help is also available in the form of the BATC telephone BBS, so you can ask questions, leave messages or download news and software, all related to ATV.

Help Line number: 0767 317521

The Principles of Television

The Signal

All forms of picture transmission and reception differ from normal 'seeing' with a human eye in one important respect, the human eye uses about 150 million simultaneous channels of visual communication, but an electronic system uses only one channel at any instant in time. Consequently, a process termed 'scanning' has to be used, whereby the visual information to be transmitted and received is explored bit by bit and translated into electrical terms for modulating a television transmitter. The received signal is demodulated and used to build up a reconstituted picture on the screen of a cathode-ray tube (CRT).

Scanning

To simplify the explanation we will consider a picture made up of only eight lines and displaying a black square in the centre of the screen.

Scanning requires, firstly, that the picture to be transmitted is framed in a field of view having an 'aspect ratio'. The standard aspect ratio for television is 4x3 units as shown in Fig.1(a). It can be seen that the actual picture size is of no importance so long as the aspect ratio is correct.

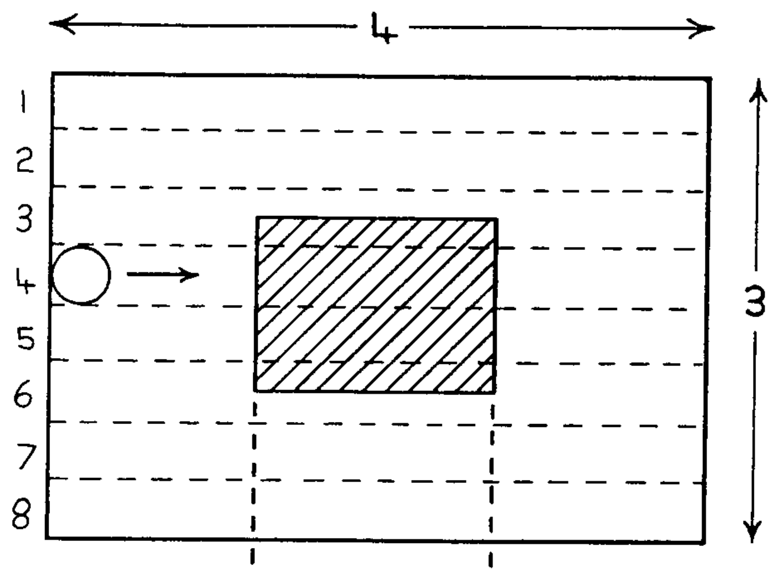


Fig.1a

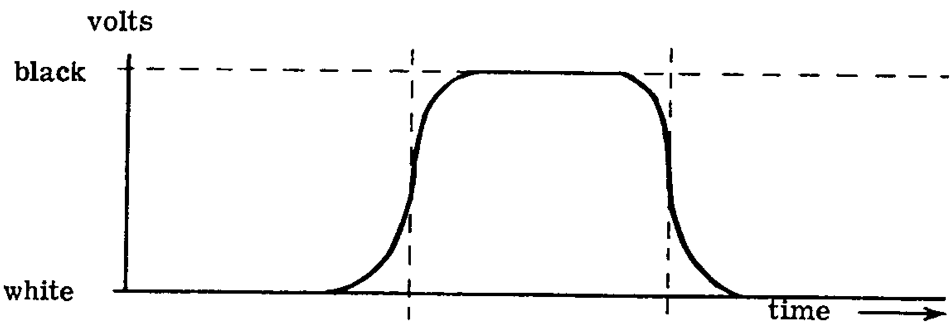


Fig.1b

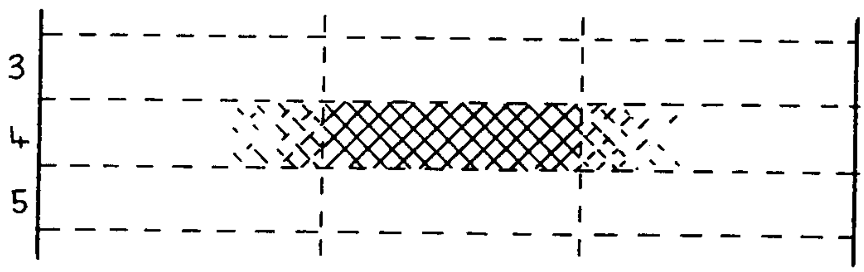


Fig.1c

Fig.1(a) shows a scanning spot that traverses the field line by line, (similar to the manner in which we read a book), translating the variations of light and shade (and possible colour) into voltage variations which are used to modulate the transmitter. The camera, with its optics and electronics, carries out this operation.

At the receiver, a CRT beam is swept across the face of the tube in synchronism with the camera scan, and the demodulated signal is used to modulate the beam current, thus writing a reproduction of the picture scanned at the transmitter.

All broadcast television systems use a technique called ‘interlaced scanning’, this means that the screen is scanned and every other line is displayed onto the screen, during the next scan the in-between lines are displayed, thus completing the picture. Referring to the eight line picture in Fig.1(a), interlaced scanning would require that the complete field would be scanned by lines 1, 3, 5 and 7 and the gaps would be filled by re-scanning the field with lines 2, 4, 6 and 8.

Picture quality is determined by the scanning spot size and, therefore, the number of lines required to fully scan the field. There are many reasons why amateur television should follow existing broadcast standards, not least of which is the availability of equipment. In the UK the terrestrial standard is 625 system I, which is as follows: -

NUMBER OF LINES PER PICTURE	625
INTERLACE	2 to 1
ASPECT RATIO	4 to 3
LINE FREQUENCY	15.625kHz
FIELD FREQUENCY	50Hz
COLOUR SUBCARRIER FREQUENCY	4.43361875MHz
VIDEO BANDWIDTH	5.5MHz
SOUND SUBCARRIER FREQUENCY	5.9996MHz
COLOUR SYSTEM	PAL

Fig.1(b) shows the voltage obtained by scanning (say) line four of the picture. Because electronic circuitry cannot respond instantly, the changes from white to black and from black to white at the edges are not sharply defined. To improve resolution, the spot is made smaller and the number of lines increased.

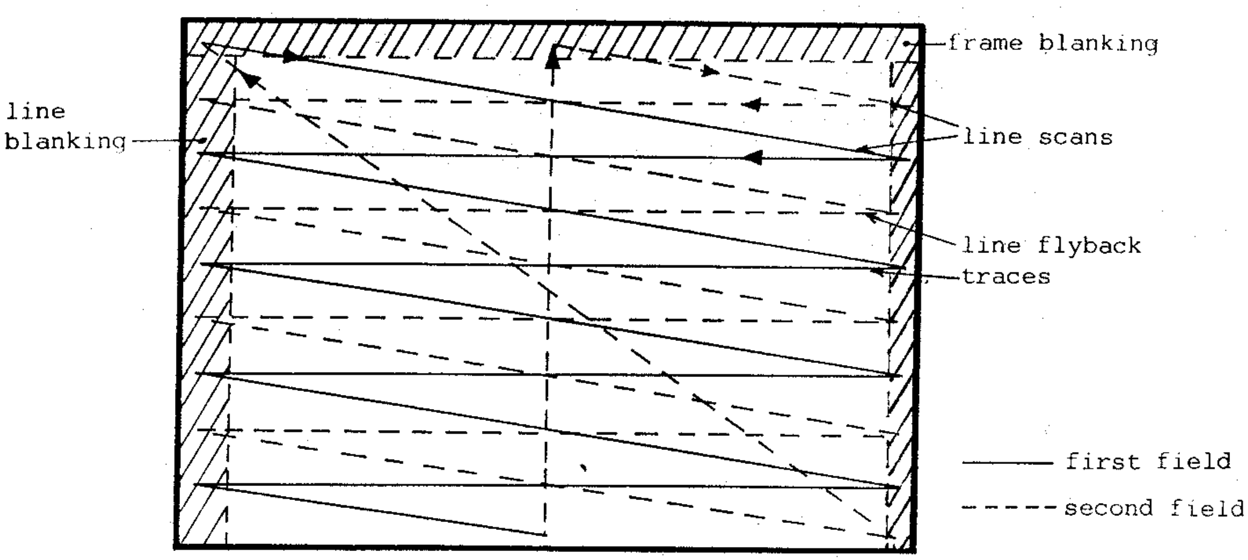


Fig.2: Interlaced Scanning

Television, in dealing with moving pictures, requires a complete scan of the field to be so fast that, compared with any movement taking place in the scene, each complete scan is of a virtually still picture. Standard broadcast television in the UK scans at 25 pictures per second.

Fig.5 shows a typical waveform for a single line of 'composite' video (combined video information and synchronising pulses). One complete line of a television picture takes 64uS to scan from left to right across a TV screen. There are 625 lines per frame and 25 complete frames occur each second. Each frame is divided into two interlaced fields of 312.5 lines each, which are scanned sequentially. A total of 50 individual fields therefore are scanned each second (50Hz). The line, or horizontal deflection frequency may be calculated thus:

50 x 312.2 = 15.625Hz

When a line has completed its scan, the spot on the TV tube is retraced very quickly to the start of the next line at the left hand edge of the screen, this operation is called 'flyback' (Fig.2). In order to avoid this trace from being visible on the screen the picture is blacked out (blanked) during the flyback period. Fig.5 shows this time period to be 12.05uS.

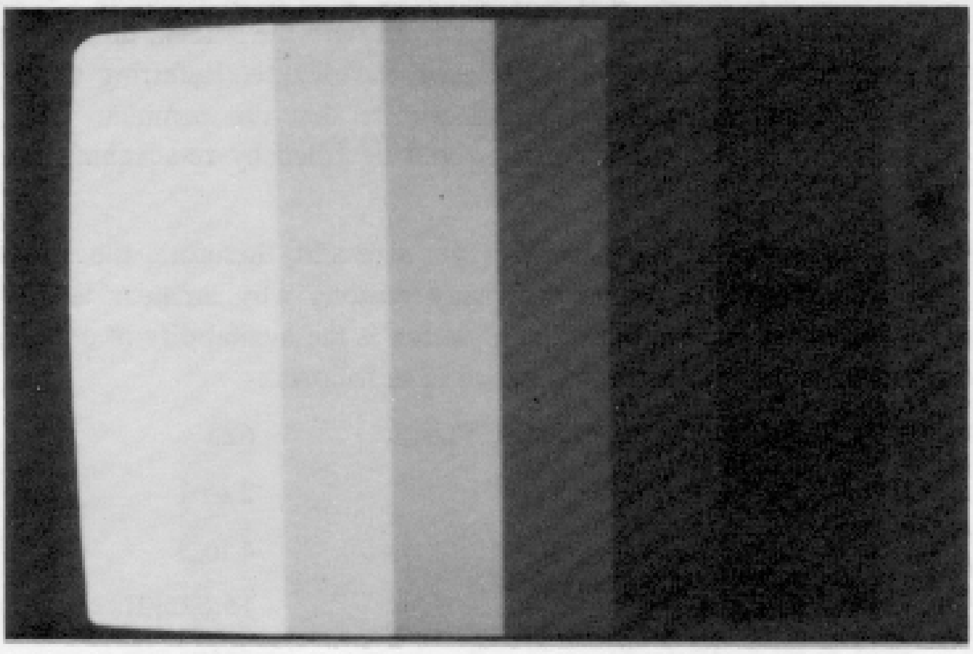


Fig.3: A Grey-Scale picture on a Monitor

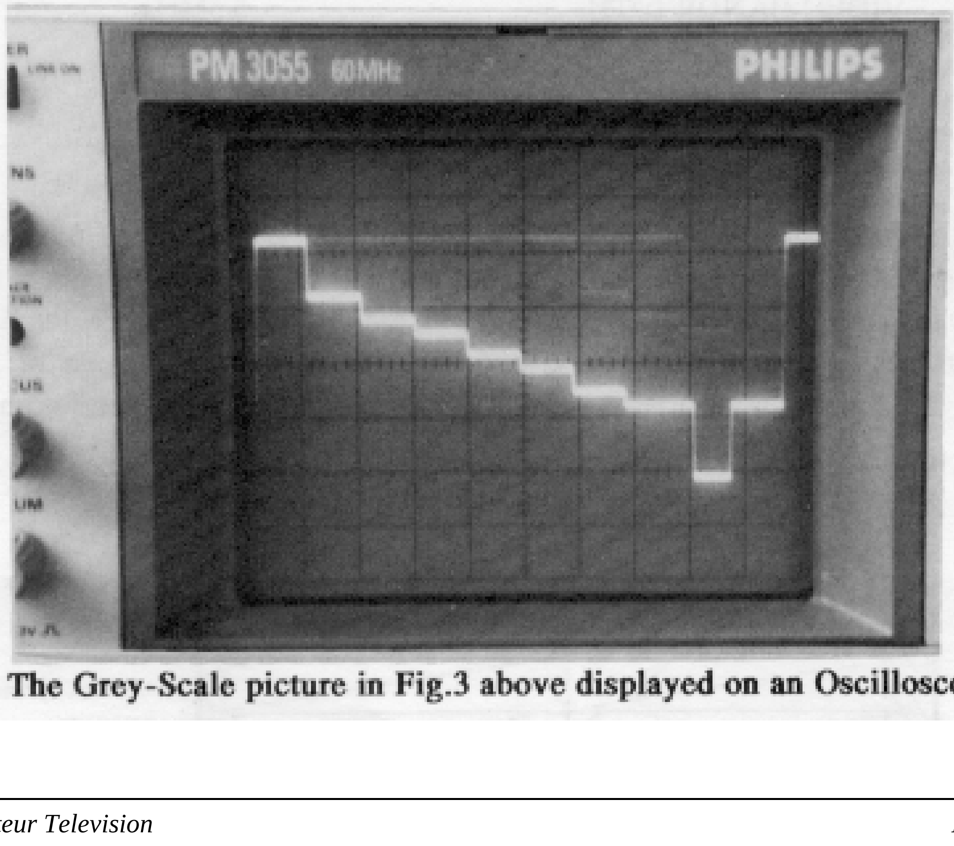


Fig.4: The Grey-Scale picture in Fig.3 above displayed on an Oscilloscope

The synchronising pulse to trigger the scanning spot is placed within the blanking period, this ensures that the sync pulses are not affected by the vision information. The period between blanking and the start of the sync pulse is called the 'front porch' and that from the end of the sync to the end of blanking is called the 'back porch'. If the signal is a colour signal then a 'burst' signal may be contained within the back porch.

The composite video signal has a standard amplitude of 1 volt peak-to-peak, that is from the bottom of the sync pulse (sync tip) to the top of the video information (peak white). Fig.5 shows the correct level at which sync information starts, this point is called 'black level'. A picture consists of black and white with many shades of grey in between, these shades are represented by different levels of video amplitude. The staircase (grey-scale) waveform shown in Fig.5, if displayed on a TV screen, would result in picture similar to that shown in Fig.3, and if displayed on a oscilloscope would result in a picture similar to that in Fig.4. A grey-scale commencing with a vertical black bar on the left and ending with a pure white bar on the right.

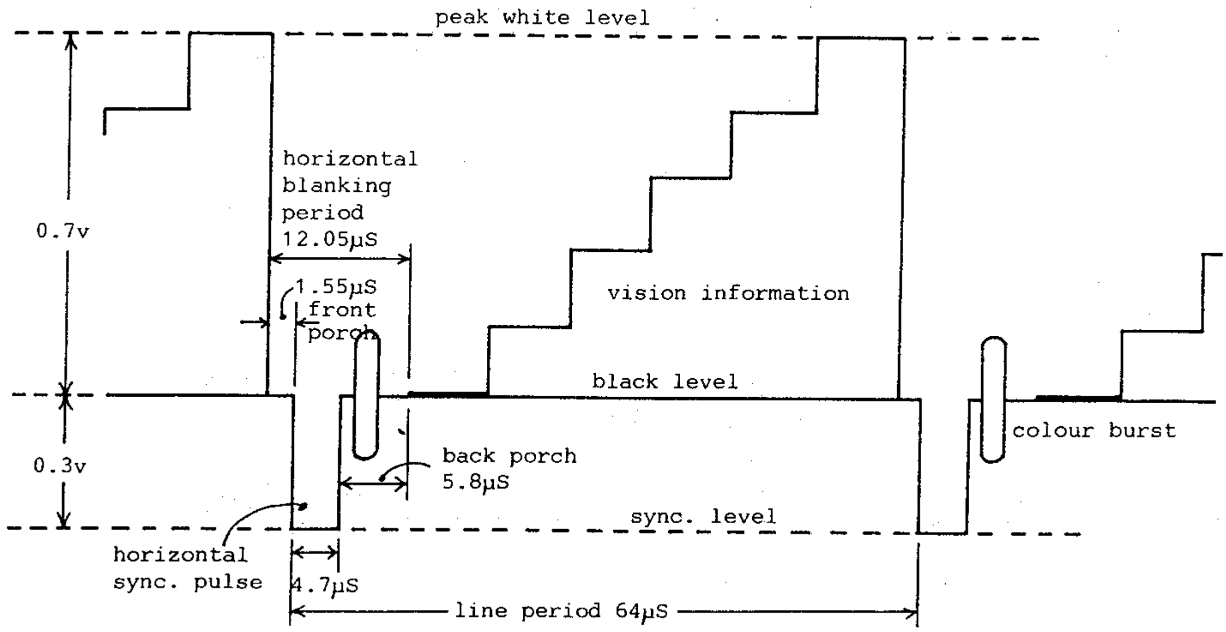


Fig.5: A Composite Video Waveform

Colour TV

Colour TV signals are the order of the day on the 24cm band. The Switching, mixing and RF circuits in this book are all capable of passing colour TV signals. To send a colour signal it has only got to be derived from a colour source (some of the signal sources are not colour, these are intended as simple confidence building blocks for the beginner).

NOTE: When a colour signal is to be radiated on the 70cm band a suitable filter should be included to remove the colour and restrict the bandwidth on this very crowded band.

A colour signal can take two basic forms: the first is a system called RGB, where three separate waveforms are generated for each of the three primary colours Red Green and Blue. The waveforms are shown in Fig.6 and are called non-composite. Sometimes, one or more of the waveforms carries sync information, usually the Green waveform. This format is relatively new and is called GBR. The Green comes first because it carries the sync information.

By varying the amplitudes of these three RGB or GBR signals, it is possible to produce any colour which the TV system is capable of reproducing. For example: if a signal was present on the red channel only, then a red picture is produced. If equal amplitudes of say, red and green were generated, a yellow picture would result. A peak white signal would be produced if the red, green and blue channels were all fed with their maximum amplitude (0.7v) signals. Furthermore, if the red, green and blue amplitudes were kept equal, it would be possible to display any amplitude of monochrome signal. i.e.; if R = G = B, then a monochrome signal will always be produced.

Fig.6 shows the colour equivalent of the monochrome signal shown in Fig.5. Note that the red, green and blue (RGB) form of colour signal is ALWAYS non-composite, thus to feed a colour monitor four wires will be required, one each for red, green, blue and synchronising pulses.

Coding and Decoding

The colour signal in its RGB form differs little from a monochrome signal, except that there are four of them instead of just one, Red Green Blue and Sync; this form is suitable for feeding a video monitor and is often used by computers to drive a VDU. Undoubtedly this is the best system, since the signals do not become distorted due to deficiencies in the coding and decoding circuits. If, however, the colour signal needs to be transmitted over the air, or fed into a domestic receiver (via a modulator), or if there are several sources to be switched or mixed, then the RGB signal has to be coded.

This process of coding produces a single composite signal, which provides all the information necessary to reconstitute the original RGB and sync.

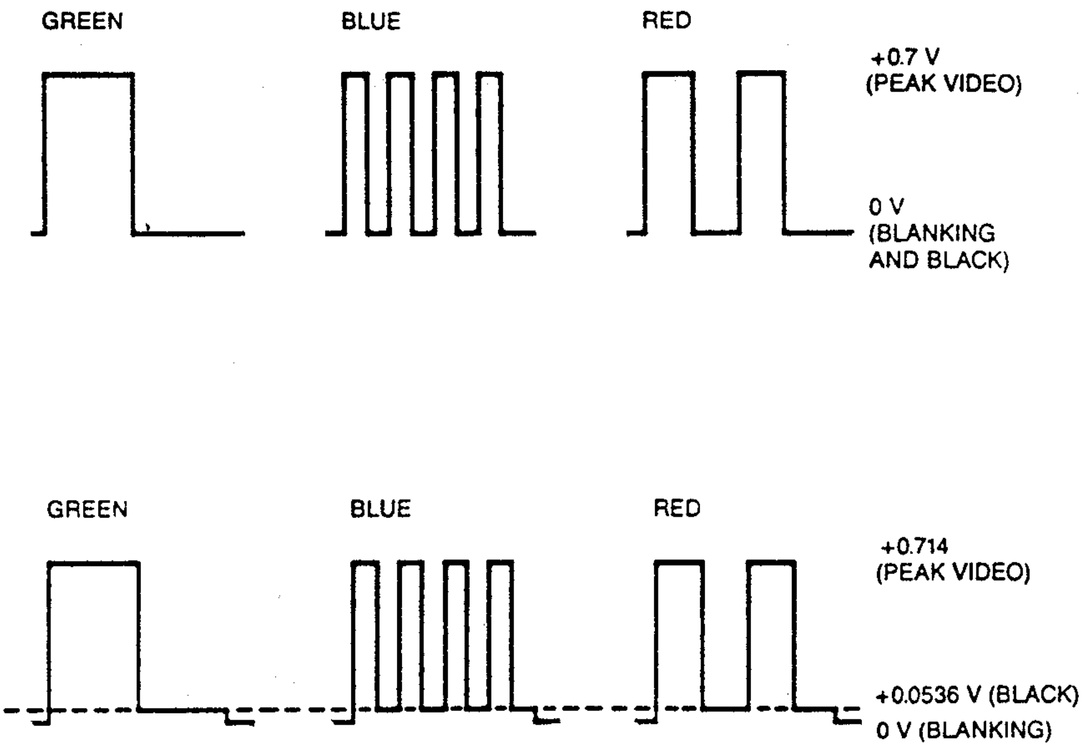


Fig.6: Non-Composite R, G and B Waveforms: upper PAL, lower NTSC

The Phase Alternate Line System (PAL)

It is now necessary to briefly explain how the PAL system was developed since it will assist in the understanding of the operation of colour coders and decoders.

The 'Y' Signal

Use is made of the very important fact that the human eye cannot resolve fine colour detail, only detail in terms of brightness, regardless of colour. In a monochrome system there is already a signal which defines the brightness of a scene. This signal (the normal video output of a monochrome camera) is of sufficient bandwidth to define the fine detail of a scene. In colour terms, this signal (the black and white information) is called the LUMINANCE signal, and is usually given the symbol 'Y'. To produce a compatible composite colour signal the colour difference must somehow be added to the Y signal. The various colour systems such as SECAM, NTSC and PAL all use some form of RF modulation of a carrier, which is then superimposed onto the Y signal, with the exception of the recent DMAC system.

Use is made of the fact that the colour part of the signal need not be of such a wide bandwidth as the Y signal. In practice, the Y signal bandwidth is of the order of 3.5MHz in amateur transmissions (the broadcast standard is 5.5MHz) whereas the additional colour information has a reduced bandwidth of 1.1MHz.

The question now is, that given an RGB colour source, how can the Y signal and colour information be obtained from it? Each colour has its own brightness level, and the red, green and blue signals all contribute to the brightness levels of the scene. Therefore, by adding together defined proportions of the R, G and B signals, it is possible to obtain the Y signal. The actual relationship is:

Y = 0.299R + 0.5876G + 0.114B

Fig.7 shows a circuit which will derive the Y signal from the RGB signal so that the monochrome component can be observed.

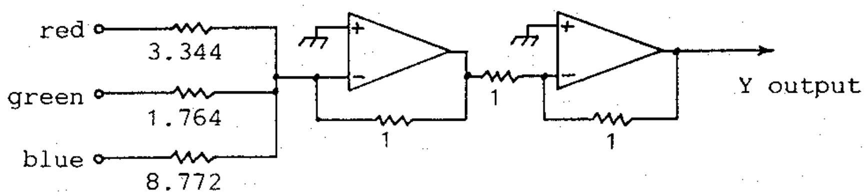


Fig.7: Generating Y from R, G & B (Note: the figures are scales values and not actual values in ohms)

Colour Difference Signals

Having obtained a luminance signal, the colour information must be derived and added to it. There is no point in including the Y signal in the colour information, therefore it is subtracted from the RGB sources to provide signals containing only the colour information. The colour signals thus produced are R-Y, G-Y and B-Y. These are aptly called 'colour difference signals'.

A certain amount of study will show that it is only necessary to transmit two of these signals in addition to the Y signal for the necessary information to be recovered. This is shown by the following relationships: consider the three signals Y, (R-Y) and (B-Y), at the receiver R and B can be obtained by:

R = (R-Y) + Y, and B = (B-Y) + Y

but Y = R + G + B, thus the green signal can be obtained from the other three signals, i.e:

G = Y - R - B.

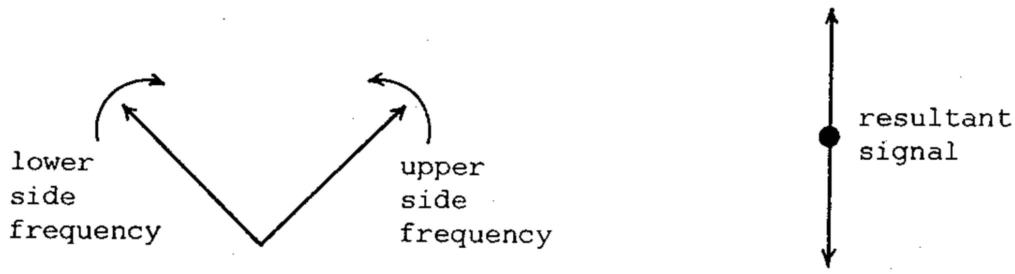
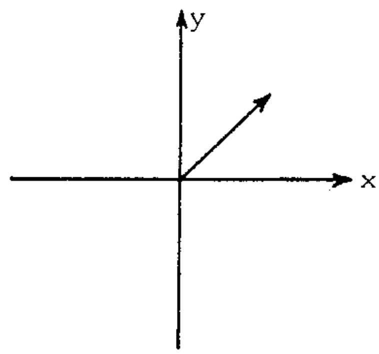


Fig.8: DSB Modulator Vector Diagrams



Fig's.9 : Second DSB Modulator Vector Diagram

Fig.10: Addition of Vectors

To sum up so far, it is necessary to transmit two additional signals for colour; B-Y and R-Y, each having a bandwidth of 1.1MHz. The PAL system is an adaptation of the NTSC system (The American 'National TV System Committee' system) so for the moment the NTSC system will be considered, and then an explanation will be given to show how it has been modified to PAL to get over some of the initial problems.

The National Television System Committee Standard (NTSC)

To add the colour signals onto the Y signal, they are modulated onto a carrier. To explain how this is done, first consider a double sideband suppressed carrier system modulated with a sine-wave source. Fig.8 shows the vector diagrams of the modulator output. (These diagrams are rotating at the carrier frequency). The resultant signal is seen to have a phase which is either 0 or 180 degrees with respect to the carrier. The amplitude is a function of the modulating signal voltage and its phase is a function of the polarity of the modulating signal.

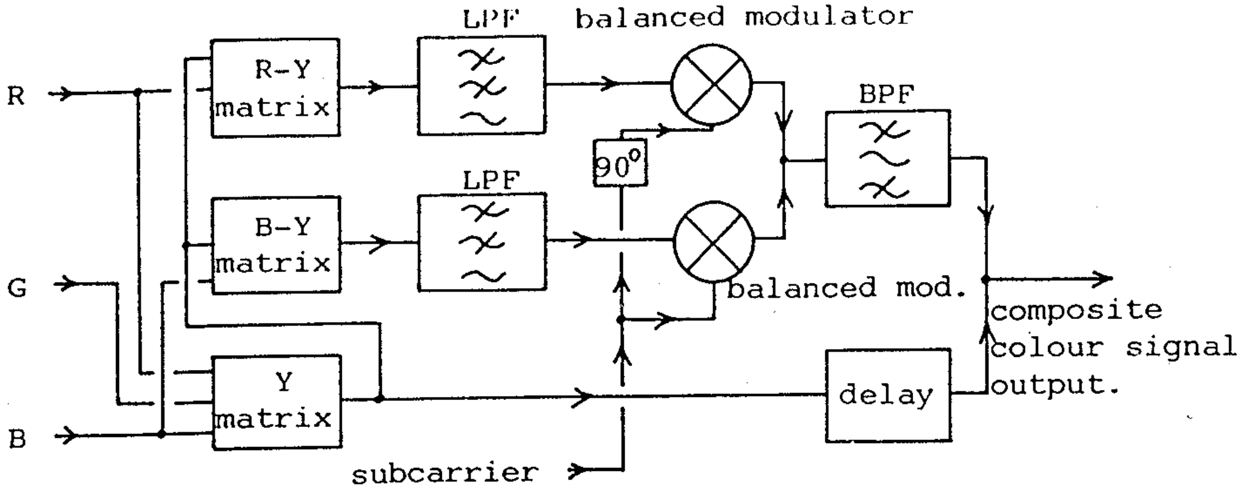


Fig.11: Block Diagram of an NTSC Encoder

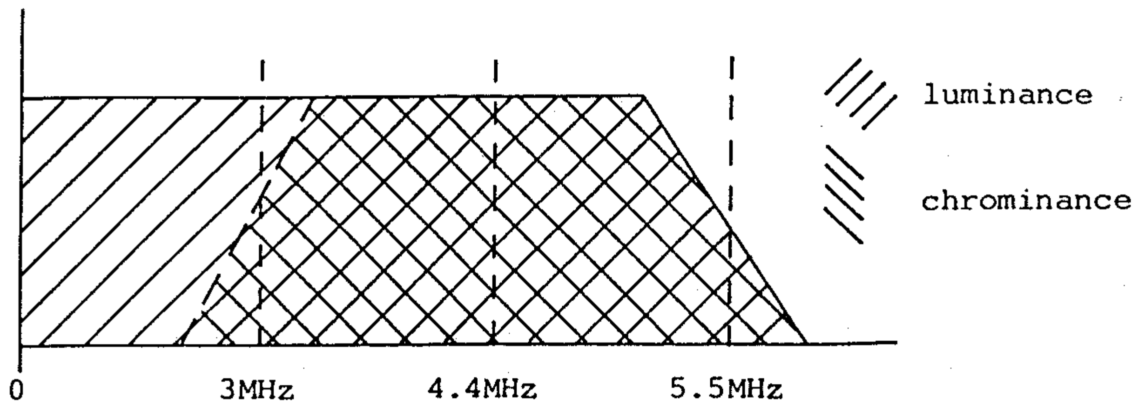


Fig.12: The Spectrum of an Encoded Colour signal (PAL System I)

A second DSB modulator is fed with a different modulating signal and a carrier which is 90 degrees out of phase with the original, producing the resultant vector shown in Fig.9. The outputs can now be added together, which produces a resultant signal of variable amplitude and phase (Fig.10). Fig.11 shows the block diagram of an NTSC encoder.

Since the two components x and y are in quadrature, it is possible to demodulate them back into two independent signals: this is achieved using two synchronous demodulators (i.e: fed with 0 and 90 degree subcarrier). In the NTSC system, the B-Y signal is modulated onto the x axis and R-Y onto the y axis. Fig.11 shows, in block form, how the colour signal is generated.

A big advantage of using a suppressed carrier form of modulation, is that the lower the colour content of the picture (saturation), the lower is the amplitude of the subcarrier, and, in fact, in the absence of colour, the subcarrier disappears completely, and the signal reverts back to its monochrome form. This fact is important as the subcarrier is within the video band and results in patterning on the television screen.

The spectrum of the colour signal is shown in Fig.12 and illustrates how the chrominance occupies the upper part of the luminance bandwidths.

So far, no mention has been made of how the subcarrier for the decoder's synchronous demodulators is obtained. At the coder, a 'burst' of subcarrier is added to the signal. As within the back porch period in PAL, the phase of this burst is constant and is on the (B-Y) axis. At the decoder, a phase-locked loop (PLL) is used, comprising a varactor controlled crystal oscillator and a gated phase detector. The phase detector is arranged to compare the phase of the locally generated and the received subcarrier, only during the period of the burst: this is called the 'burst locked oscillator'. Fig.13 shows the arrangement for decoding the composite NTSC signal.

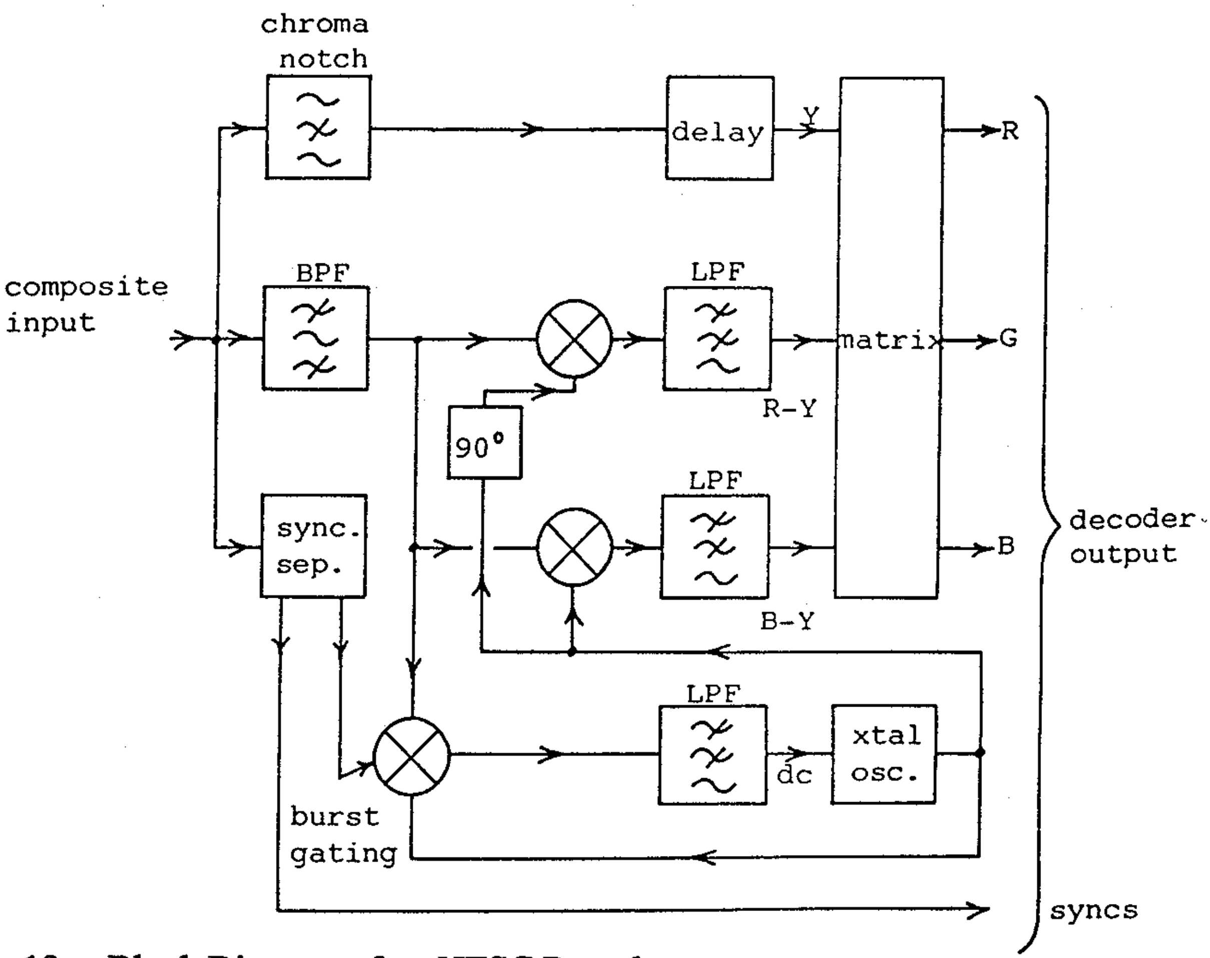


Fig.13: Block Diagram of an NTSC Decoder

The Pal System

The parts of the NTSC system so far described, are identical to PAL. The PAL system has, however, one distinct difference: in this system, the R-Y axis is reversed in polarity on alternate lines at the coder. In the decoder, the subcarrier feed to the R-Y demodulator is reversed in phase in step with the coder. It can be seen that this arrangement produces exactly the same signals as before, so what is the point?

There is a distortion which a colour signal can suffer which is termed 'differential phase'. This is the effect whereby the phase of the subcarrier component varies depending on the level of the luminance signal it is sitting on. This means that a colour object in the picture could well have the 'wrong' phase with respect to the burst which is sitting at black level. In NTSC this error would result in an incorrect colour being reproduced. In PAL, on a given line, we have (assuming we have picked the right one out of the two) an identical situation as in NTSC where incorrect colour is reproduced.

Observing the next line, the signal suffers the same phase error but, as the axis of R-Y has been reversed, the resulting colour error is in the opposite direction to the preceding line. This, taking the average of two consecutive lines, results in the correct colour being reproduced. In a single system, this averaging can be achieved by observing the picture at a distance where two lines tend to merge and the averaging is then done by the eye.

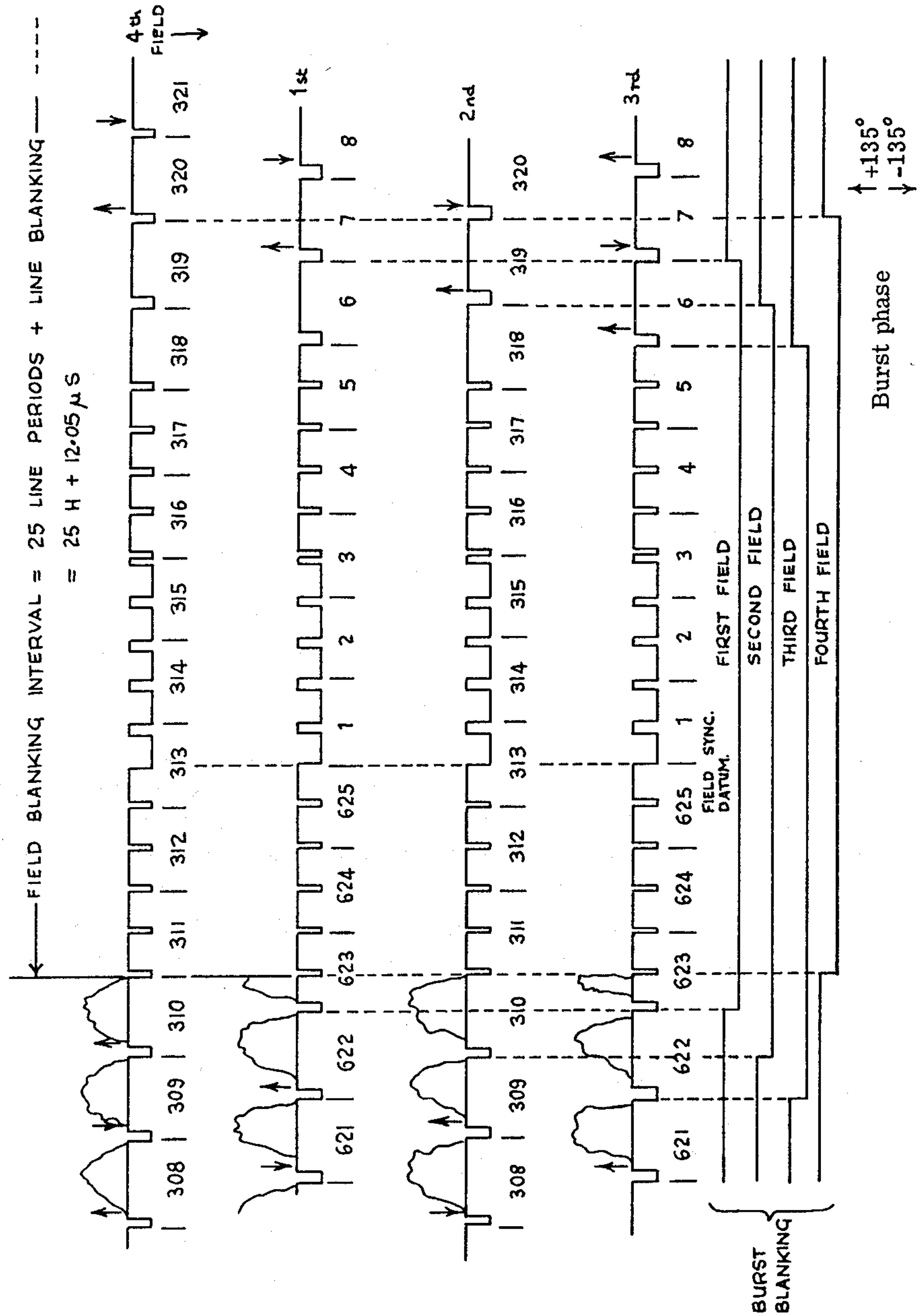


Fig.15: The Complete PAL Television Waveform

If the errors are too great, an effect called ‘Hanover bars’ results, produced by large colour differences on alternate lines. To overcome this problem, the signals on alternate lines are averaged electronically. This has the requirement that the signals from the two lines be available at the same time which means a one-line delay has to be used. Fig.14 shows how this is done. The arrangement shown also provides a rough separation of the signal into its R-Y and B-Y components prior to the synchronous demodulators.

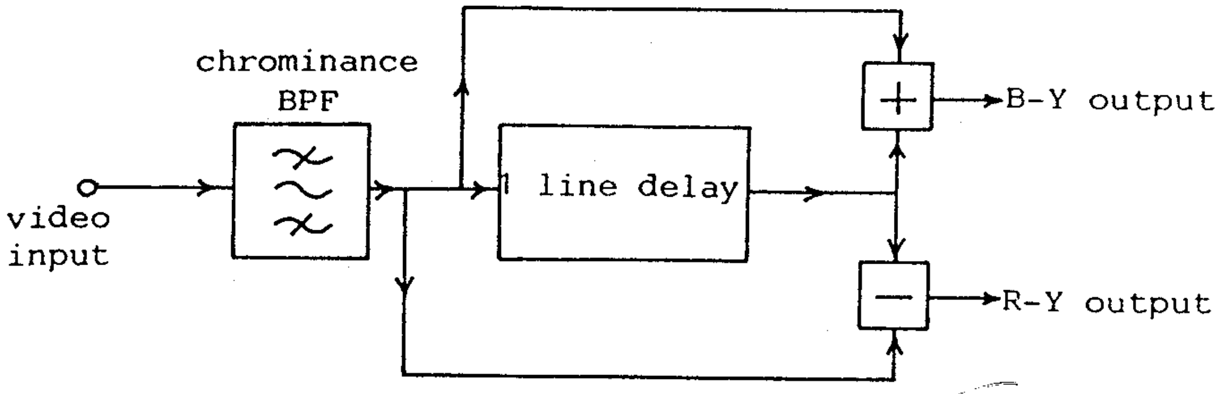


Fig.14: Delay Line arrangement in a PAL Decoder

The one remaining problem for the PAL decoder is identifying the lines which are transmitted with the R-Y phase reversed. This is done by moving the phase of the burst on these lines. The PAL colour burst has two distinct phases +45 degrees and -45 degrees with reference to the B-Y axis. The decoder produces a subcarrier of 0 degrees from this colour burst for decoding the B-Y. The decoder also produces a second subcarrier which is shifted in phase by 90 degrees for demodulating the R-Y, the phase of this second subcarrier is reversed, or shifted, by 180 degrees on the alternate lines which are identified by the -45 degree burst. The result is the original B-Y and R-Y signals. The R-Y and B-Y signals and Y signal can be matrixed back together to recover the original RGB signal, each one then being used to modulate the appropriate electron beam within the CRT and illuminate the correct colour phosphor on the screen, where the picture is recreated. The extra complications of the PAL system add a great deal of phase distortion immunity to the system which is very important when sending TV pictures over radio frequency link. The final polish to the PAL system is often not achieved by amateurs, in that the colour subcarrier 4.43361875MHz is a frequency chosen so as to interleave the colour and monochrome side bands. This interleaving minimises any objectional subcarrier patterning on the screen. The subcarrier is locked to line frequency with a subtraction of 25Hz, so that any subcarrier patterning will crawl slowly up the picture. This can often be seen if you look at the PAL signal present on a saturated colour picture, compare the results of broadcast picture and a computer generating a PAL signal, the latter will probably not have the correct subcarrier to line relationship.

The last fix the broadcasters apply to their output is to remove some of the colour bursts during the vertical interval, so that they always finish on a +135 degree burst and recommence the new field on a +135 degree burst. This is known as Bruch blanking as in Dr. Bruch who put the PAL system together. Amateurs will have colour bursts blanked in the vertical interval too, but this is often done by using a simple waveform known as field blanking and not the more complex waveform Bruch blanking, which ensures the correct sequence. This is not a problem on modern receivers, but in the early days of colour TV some sets had poor colour lock at the start of picture and required Bruch blanking to fix the problem. These last two fixes in the PAL system are often omitted in ATV stations for reasons of simplicity.

We have reproduced the complete TV waveform in Fig.15, it shows four fields or scans of the TV signal. Arrows have been used to indicate the phase of the colour bursts. The individual TV line in Fig.4 is a better representation of what a colour burst looks like on an oscilloscope. Fig.15 also shows the vertical interval where a chain of pulses is detected in the receiver and used to command the CRT trace from the bottom of the screen back to the top.

The other thing Fig.1 (c) shows is that PAL is a four-field system, because of the R-Y reversal on alternate lines, and how this fits into the interlaced scan of odd and even fields. This is what the inventors of PAL believed at the time and has subsequently been proved to be an eight-field repetition, for reasons that are well beyond the scope of this beginner’s book.

Setting up your TV Station

The Video Section

Connecting video equipment together is as simple as audio equipment, once you have mastered a few rules. The composite Video signal (Fig.5 in chapter 2) is a one volt peak-to-peak signal when terminated in 75 ohms. This is the standard which composite video is always exchanged at, to understand what it means let's look at a video output stage.

Fig.1 shows an emitter-follower output stage that is typical of a piece of video equipment. The signal at the emitter of the transistor is 2 volts peak-to-peak, not 1V. In series with the output is a 75 ohm resistor which builds the output impedance up to 75 ohms.

Fig.2 shows a typical video input stage that presents 75 ohms to the signal. When the two pieces of equipment are connected together via a coaxial cable then the 75 ohms resistors at the output and input respectively form a 6dB attenuator, so that the 2 volt signal at the output of the emitter-follower becomes a 1 volt signal when terminated in the 75 ohms presented by the resistor to ground at the base of the input circuit transistor.

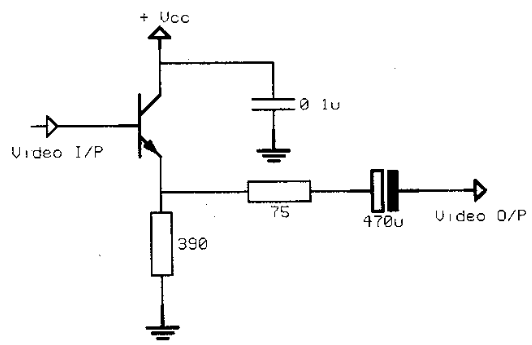


Fig.1: A typicalVideo output stage

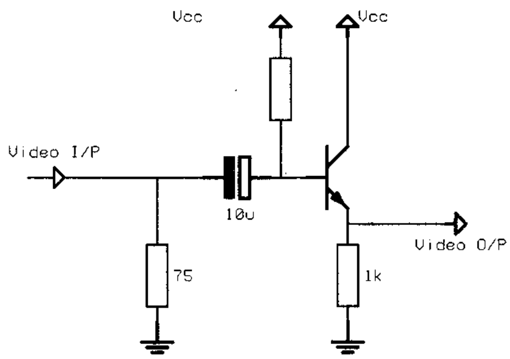


Fig.2: A typical Video input stage

NOTE: For those of you who are not conversant with dB notation, a 6dB change in VOLTAGE represents a change of the order of two, that is x2 for gain, or x0.5 for attenuation.

The reason for this arrangement of signal distribution is because a video signal contains RF frequencies, standing waves can be set up by lines that are not terminated correctly. This system can be further expanded as in Fig.3, where more than one input can be driven from a single output. Here, three monitors are fed from a single video source. The first two monitors must not present a 75 ohm load, only the last one. To this end, you will often find on professional monitors switches which allow you to switch out the 75 ohm resistors, called 'Bridge' and 'Term'. Sometimes the equipment input will have two sockets to allow this 'daisy-chaining' of equipment.

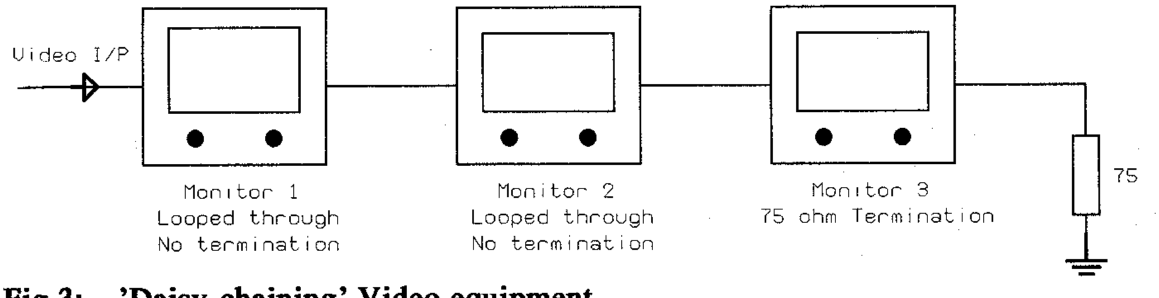


Fig.3: 'Daisy-chaining' Video equipment.

The equipment connectors used for this sort of video are BNC or PL259 connectors. One very useful piece of hardware for connecting this sort of equipment together is the ''T" piece, this exists in both BNC and PL259 types of connector and is ideal for 'daisy-chaining' equipment. If you are in doubt about the presence, or absence, of the 75 ohm resistor on the input of any piece of equipment, then it is a simple matter to check it out with a multi-meter. If the 75 ohm resistor is absent then the equipment can be daisy chained with suitable ''T" pieces, and the last piece of equipment can have a 75 ohm resistor fitted into a BNC or PL259 plug and inserted at the end of the line.

Home Video equipment also obeys these rules, only the composite signal is often presented on Phono plugs and provision is not always made to switch out the resistor. If only one piece of equipment insists on presenting 75 ohms to the line then it can be incorporated at the end of the line, more than two and you have a problem. Sometimes the resistor is conveniently mounted on the input socket of the equipment, and can be removed, sometimes not, and a different way of distributing the composite signal is required.

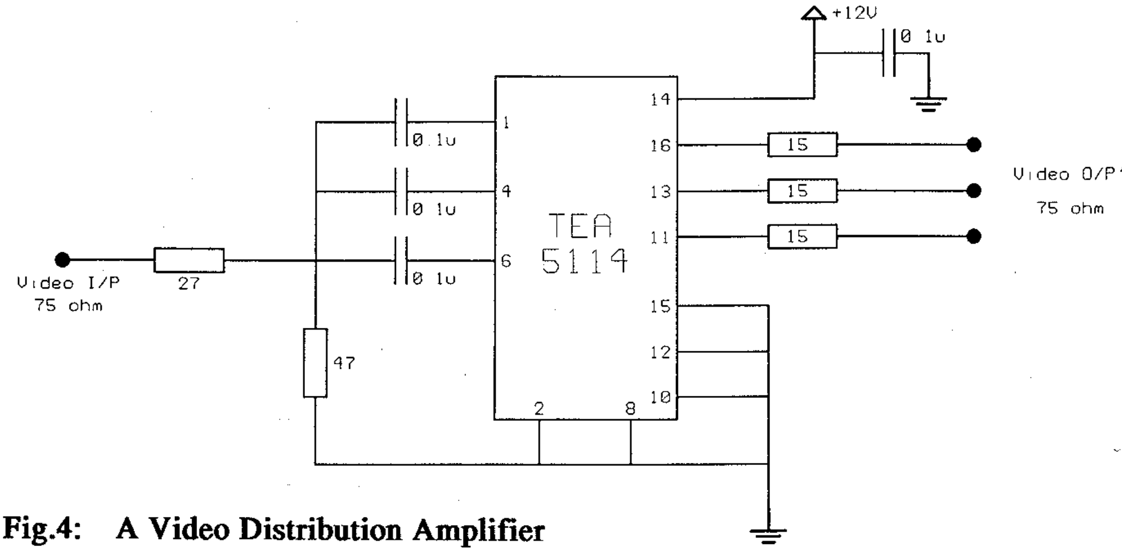


Fig.4: A Video Distribution Amplifier

Fig.4 shows the circuit of a Video distribution amplifier that has one input and 3 outputs. Each video output can drive a single 75 ohm load, be that a daisy chain or single piece of equipment.

Another problem of video distribution is cable equalization. This problem only effects long cable runs, i.e: over 10ft, and is not often a problem to amateurs and home video enthusiasts because they do not get involved in long cable runs. The problem is caused by losses in the coaxial cable, which are greater at the higher video frequencies. To compensate a cable equalizer is required, sometimes this is built into the video output stage and will deal with up to 20ft of cable, more than that and you will need an external equaliser.

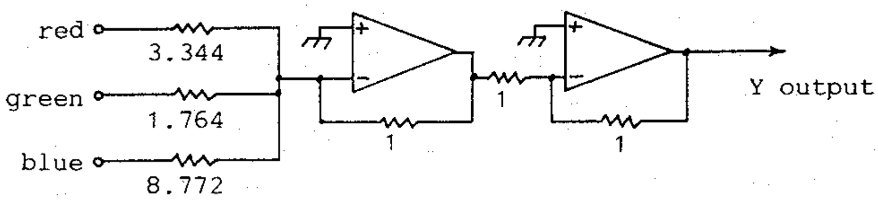


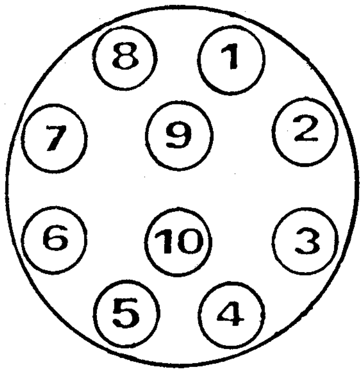
Fig.7: Generating Y from R, G & B (Note: the figures are scales values and not actual values in ohms)

These equalisers need adjusting for different lengths of cable. If an oscilloscope is available it should be connected to the end of the cable run and the 'EQ' control set for equal amplitude of LF and HF. This requires a video test signal such as a multi-burst as shown in Fig.5, where discrete bands of frequencies are generated along a TV line, all of equal amplitude at the sending end. The equalizers should be adjusted so the signal arrives at the end of the long cable run in the same condition. If a TV signal with a colour burst is available, then the colour burst is the same amplitude as the sync pulse (Fig.5 previous chapter), but at a frequency of 4.433 MHz and so any 'EQ' can be adjusted so that the colour burst arrives at the same amplitude as the line sync pulse.

Remember when you are using long cable runs and setting the 'EQ' at the sending end for a correct result at the other end of the cable run, it will not be correct in the middle, an important fact when daisy chaining equipment together. In practice cable runs under 10 ft. cable 'EQ' can be ignored.

NOTE: A point worth mentioning here, is that many TV amateurs use general-purpose RF cable for interconnecting pieces of video equipment. In this case, as RF cable generally has a specification at least up to 100MHz, then problems of equalisation can be ignored. Camera or video cable, on the other hand, has a much lower frequency specification and the points discussed above must be taken into account.

Phono, BNC and PL259 are not the only sockets to carry video, some of the equipment manufacturers like using multiple-pin plugs and sockets to carry power and audio, as well as video. Fig.6 shows the 10-pin round plug and socket that was popular for interconnecting cameras to video recorders before the camcorder arrived. The connections are shown in Fig.6 and are useful for running the camera separate from the recorder. Beware with this socket, Fig.6 shows the most popular configuration, other configurations have been used.



Pin	Connections
1	Video output
2	Vodeo output ground
3	Vertical sync
4	Vertiacl & Horizontal sync ground
5	Horizontal sync
6	Remote switch
7	Audio Output
8	Audio Output ground
9	Supply voltage ground input
10	Positive supply voltage input

Fig.6: The 10-pin Camera Plug

The connectors are available from Maplin; order code RK52G for a line socket, RK53H for a line plug and RK54J for a chassis mounting socket. Sometimes the camera requires frame-rate pulses from the video recorder on pin-3 such is the case with the Sony AVC 3450CE. If this is the case then the circuit shown in Fig.7 can be used to generate them.

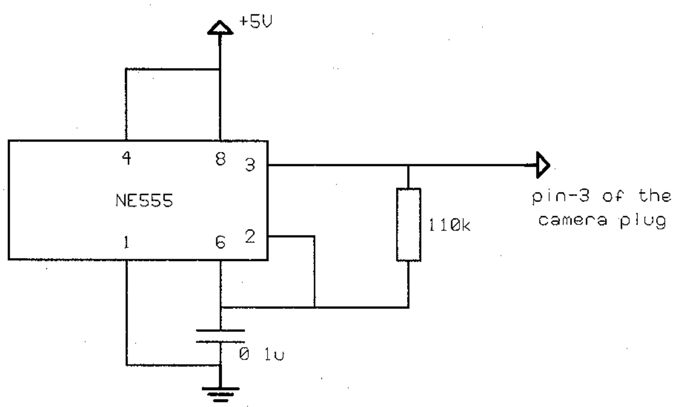


Fig.7: Frame pulse generator

Another multi-pin connector that is increasing in popularity is the SCART connector (Fig.8). This connector enables audio and video to be interconnected along a single multi-core cable as well as Composite video, it can also provide for RGB signals.

The RGB pins are not always connected, as is the case on SKY satellite receivers, where component or RGB video is not readily available. However, This is not the case for the BSB system, where receivers do provide RGB, or some computers where RGB is available on a SCART connector. Where the SCART connector is found on a domestic TV set, then RGB and composite inputs are usually implemented.

Beware when buying ready made SCART leads if you are interconnecting RGB as the connections are not always fully populated, often only the composite Video and sound are connected and if you are using such a cable to get RGB from a Computer to your TV set you would have problems, so always check out ready made leads, you may not have what you think you have.

The last socket is called VHS S. This is a four-pin socket that is starting to appear on TV sets at the top end of the market. It is for connecting S VHS equipment together using separate Luminance and Chrominance signals. This is because they are processed separately in S VHS equipment, and technical advantages exist if they can be kept separate when distributing the output of an S VHS machine.

To this end, TV receivers at the top end of the market have this four-pin input socket, that can be connected direct to an S VHS machine. The separate Luminance and Chrominance paths also exist in some vision mixers aimed at the home video producer. The general rule is that ‘what S VHS has separated should not be recombined into composite PAL’, or signal degradation will result. The reason for this is that due to the high resolution of these machines, the Luminance signal and chrominance signal overlap, but because of some short-comings in the system they can not be interleaved without some loss in quality. They can, however, be converted into RGB, for connection to a TV set with a SCART connector. Such a converter was described in CQ-TV 156.

The Rf Section

Setting up the RF side of an ATV station is virtually identical to that of a station operating any other mode. Generally, though, an ATV station will comprise more individual units than with a phone station, or whatever. For example: you will quite possibly have separate transmitter and receiver systems, themselves comprised of separate sub-units; preamplifiers, exciters, linear amplifiers, down converters, etc.

1 - Audio out, right-hand channel
2 - Audio in, right-hand channel
3 - Audio out, left-hand channel
4 - Ground for Audio channels
5 - Blue Video channel ground
6 - Audio in, mono or left-hand channel
7 - Blue Video channel input
8 - Source switching, i.e: TV/Monitor status
9 - Green Video channel ground
10 - Remote Control (inverted) or Clock
11 - Green Video channel input
12 - Remote Control
13 - Red Video channel ground
14 - Ground for Remote Control channel
15 - Red Video channel input
16 - TV/non-TV status (RGB fast Blanking)
17 - Ground for Composite Video input/output
18 - Ground for TV/non-TV status
19 - Composite Video output
20 - Composite Video input or Sync for RGB signals
21 - Socket earth (plug shield)

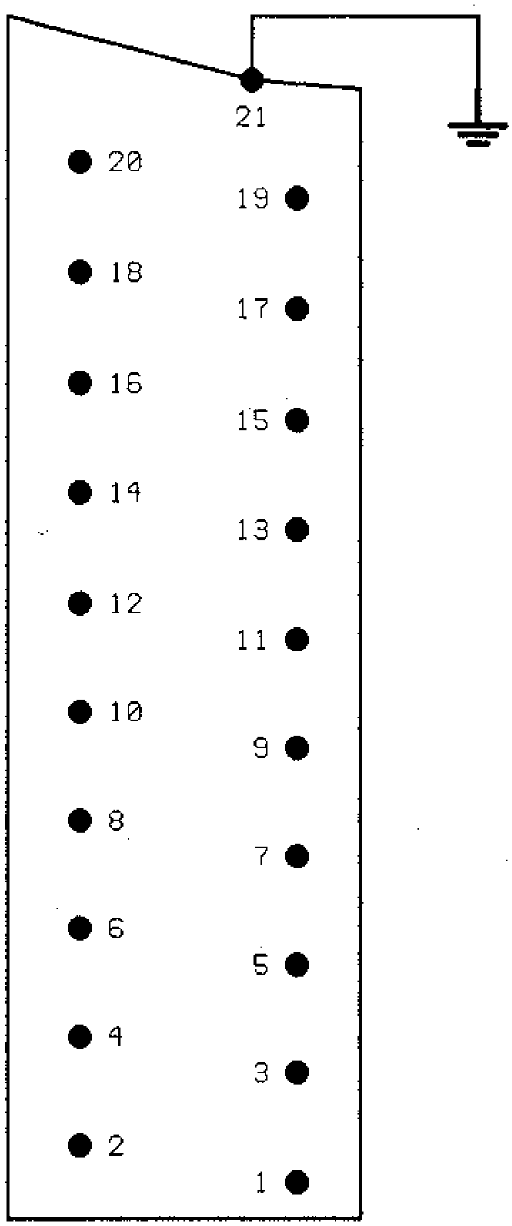


Fig.8: The SCART connector

All these units have to be interconnected and care must be taken that undue losses, or sources of interference, do not occur. Do not use just any old piece of coaxial cable to connect the various units together, nor use connectors that are not in perfect condition. The losses that can be achieved by the use of bad connectors and cables can be quite astonishing. For example: the use of a poor quality, or badly worn, N-type or BNC connector could lose you 2-3dB of power, which equates in real terms to approximately one third to one half, in just one connector! So beware, it is very easy to lose up to 75% of your carefully generated ATV signal before it even gets into the aerial feeder.

Coaxial Feeders

Having got as much as possible of your ATV signal to the connection to your aerial feeder, you must now consider what type of feeder is in use. This is a perennial problem for Radio Amateurs, in that a plethora of cable types and specifications abound. It is false economy not to purchase a good-quality cable of high enough specifications. Again, up to 75% of your power can easily be lost before it reaches the aerial itself.

As just stated, there are many types of coaxial feeder cables to be found with all sorts of varied specifications. The type of cable recommended is low-loss air-spaced 50 ohm cable, that is relatively easily convinced to go round corners and to be formed into loops etc. One such recommended cable is ‘Westflex 103’ (see Appendix D).

RF Connectors

Do not forget the connectors, it is recommended that whenever practical to use N-type connectors, and if this is not possible then good-quality BNC types. For low-power unit interconnections, SMC or SMD types with semi-rigid coaxial cables are highly acceptable.

NEVER use PL259/SO239 connectors for ATV use, they are really only suitable for HF work, although manufacturers still insist on fitting them to VHF equipment.

It is imperative that the connectors are fitted correctly and that if they are to be used externally that they are adequately sleeved to inhibit the ingress of moisture. N-type connectors can be obtained that are specifically manufactured for external use, and it is strongly recommended that these types are utilised wherever necessary.

Also, ensure that the connections on the aerial are soundly waterproofed. The oft-used method of applying copious amounts of Silicone-based compounds, whilst excellent at stopping moisture from penetrating, is not in itself the best method. Most aerials are manufactured from Aluminium, and unfortunately a long-term chemical action between Silicone and Aluminium takes place, resulting in the Aluminium being rendered into a fine dust - not the most ideal radiator! It is better, therefore, to obtain one of the many other proprietary brands of Silicone-less waterproofing agents and use this.

Finally on the subject of feeders, do not forget to bind all connector-to-connector junctions in the cable-run with self-amalgamating tape. This will provide yet another excellent moisture barrier.

Aerials

There is a varied selection of aerials around that are suitable for ATV use on 70cm, many of them specially manufactured versions of general-purpose 70cm ones that have been ‘cut’ to give a wideband response over the 430-440MHz section of 70cm, where ATV is operated.

Generally, straight-cut Yagi aerials are used, in single or multiple arrays. Such manufacturers as MET, Sandpiper and Jaybeam, amongst others, supply specially made ATV aerials for 70cm (Appendix D).

For 24cm working a more specialist aerial is required due to the more difficult nature of propagation at these low-microwave frequencies. The most notable type in use is the Quad-Loop Yagi, which is a variation on the normal straight-cut variety, utilising accurately dimensioned loops as the radiating and directing elements. Some stations even use dish aerials, although these are invariably impractical for most stations to use.

A type of aerial that was very popular when 24cm ATV operation started was the Helical aerial. Whilst this type of aerial has the advantage of accepting signals polarised in either mode (vertical or horizontal) it will always exhibit at least a 3dB (half power) loss against a correctly polarised aerial (see the section on polarisation below). However, one big advantage of this type of aerial is that it is naturally wideband, and considering that the 24cm ATV band is some 80MHz wide this is very useful.

With Quad-Loop Yagi aerials some compromises have to be made with gain to achieve the necessary wideband attributes in a single aerial. Hence, many 24cm ATV stations use two separate aerials, one for transmit and one for receive (this is only really pertinent for repeater working, for simplex operation you can of course receive and transmit on the same frequency), which is not a problem, for as was stated earlier, most station are comprised of separate transmit and receive systems, especially at 24cm.

Aerials for 24cm ATV operation are less numerous than those for the lower bands. However, suitably recommended types can be obtained from Sandpiper and JVL (Appendix D).

Finally, on the subject of aerial systems, whilst every effort is usually aimed at maximising the gain of an aerial system, put some thought into the resulting directivity. Very high-gain aerials exhibit very narrow beamwidths, and this is even more pertinent when co-phasing or boxing aerials together. It may be advisable, if using a very high-gain aerial system, to have a relatively lower gain but wider beamwidth aerial available.

It invariably happens that the station you hear calling ‘CQ ATV’ or whatever on the talk-back frequency is actually on the back of the beam! With a narrow beamwidth aerial system the ATV signal is very much harder to find and beam up on, with a wider aerial the initial location of the signal is much easier - especially when attempting to find that DX station!

Aerial Polarisation

ALL amateur television is transmitted with horizontal polarisation. This is an internationally agreed standard and makes a great deal of sense. The cross-polarisation loss between horizontal and vertical is approximately 35dB (a lot!). Therefore, it makes sense to have an internationally agreed standard, so that when lift conditions occur (and they sometimes do!) then at least everyone is working the same propagation mode.

However, things are not quite as simple as that, the physical laws of our universe are perverse to say the least. A radio signal that starts its journey polarised horizontally may end its journey anywhere between horizontal and vertical. This is due to many reasons and the scope and maths of them are far too deep to enter into here.

Suffice it to say, that it could be beneficial to either have a Helical aerial available for switching into the system to see if any improvement can be obtained, or, in the extreme case, utilise a mode-changing rotator system that will rotate the aerial system from horizontal to vertical. It could be found that the best signal reception is achieved between the two.

Another misconception often encountered is aerial height. Whilst it is certainly imperative that ATV aerials are clear of any immediate obstructions (within several hundred yards at least) such as buildings, trees, etc., it may not be necessary to have an aerial installation so high that a red light is needed at the top! Experiments carried out by the author in the past have revealed that over a reasonable path of 30 or so miles, reception of a 24cm ATV picture was improved by lowering the mast to an intermediate height.

This is due to the nature of microwave propagation - it is very much line-of-sight. Yes, signals will bounce off objects, but generally they behave very much like a beam of light. You can see the beam from almost any radial position from the source, but the brightest light is seen when viewing line-of-sight to the light source.

Furthermore, as stated above, microwaves will bounce off objects, buildings, etc. Do not be surprised if the best picture is obtained by beaming the aerials at some point other than directly at the transmitter.

Video Sources

Having discussed the correct way to interconnect video equipment in chapter-3, we will now have a look at some circuits you can build for yourself. The first one uses a custom television integrated circuit called the ZNA 234.

Monochrome Pattern Generator

This device requires a 5 volt supply and an external crystal and coupling capacitor to generate synchronisation pulses and five different monochrome TV test patterns. The ZNA 234 will operate at either 625 or 525 line rate simply by grounding pin-2 for 525, and changing the crystal frequency to 2.18 MHz. Some additional circuitry is necessary to add the non-composite TV patterns and the sync pulses together to form a 1 volt composite video signal. Fig.1 shows the complete circuit diagram. IC2 is a buffer that provides sync pulses for other projects and can be omitted if not required. A printed circuit board is available from BATC Members' Services for construction of this unit (see Appendix F).

Four-Input Vision Switcher

Now we have a composite video source we should think about a way of switching between it and any other composite TV signal. Fig.2 shows a simple four-input vision switcher. The switcher uses 4 non-locking push buttons and indicates on four LED's which source has been selected. A printed circuit board is available from BATC Members' Services for construction of this unit. (see Appendix F).

The push buttons switch the four inputs of IC1 between 0 and 5 volts. This is encoded into a binary two-wire code by IC1 and stored in IC2, so that non-locking push buttons can be used. IC1 is a Priority Encoder, which means that if two or more buttons are pressed simultaneously, then the highest number button takes priority.

One half on the Dual Decoder IC3 decodes the two-wire encoded signal back into four wires to drive the tally LED's. The other half of IC3 is used to control IC4, which is a custom video switcher chip.

The video input levels are all adjustable, so that different video levels reaching the switcher can be corrected and balanced. The inputs to this switcher are terminated in 75 ohms, so only one switcher can be used in a daisy chain without resorting to a video distribution amplifier.

TTL RGB Colour Bar Generator

The next video circuit is more complex and generates some TTL RGB colour bars, that can be converted to a composite TV signal by the addition of a PAL coder. The circuit, shown in Fig.3, uses the Mixed Sync and Mixed Blanking waveforms that are supplied by IC2 In Fig.1. This circuit will only function in conjunction with Fig.1 and will not work alone.

IC1 is a TTL clock running at 16 times line speed. The mixed blanking signal stops and starts the clock at the beginning of each TV line, so that it has the same phase on each line. IC2 is a counter that divides the clock waveform by 2 to give the blue signal, and then by a further 2 for the red signal, and finally by 2 for the green signal.

PAL/NTSC Colour Encoder

If you want to transmit the TTL RGB colour bars produced by the circuit in Fig.3 then they will need encoding into a composite colour signal. Fig.4 shows a PAL/NTSC coder that will encode a source TTL RGB, such as our colour bar generator, into a composite PAL signal. The coder uses the TEA 2000 PAL/NTSC encoder chip and a 8.867238MHz crystal for PAL, or a 7.1276MHz crystal for NTSC. NTSC operation requires pin-14 of the TEA 2000 grounding.

The 270ns delay line is a Philips V8470, L1 is a 15 uH inductor and should be adjusted for maximum colour. The trimmer VC1 is adjusted for colour lock and centred in the locking range.

A printed circuit board is available from BATC Members' Services for construction of this unit (Appendix F).

An alternative to Fig.4 is the Maplin PAL coder which is available as a kit complete with printed circuit board. The blanking input on the Maplin kit is not used and should be grounded. Inputs R0 and R1 should be joined together and used as the red input, similarly B0 and B1 for the blue input and G0 and G1 for the green input. The encoder kit comes complete with a printed circuit board and an on-board modulator that will provide an RF output for driving a TV via its aerial input. This kit also has a composite video output which is probably more use for ATV work. The data sheet which accompanies it it fairly comprehensive and the kit can be assembled in less than an hour.

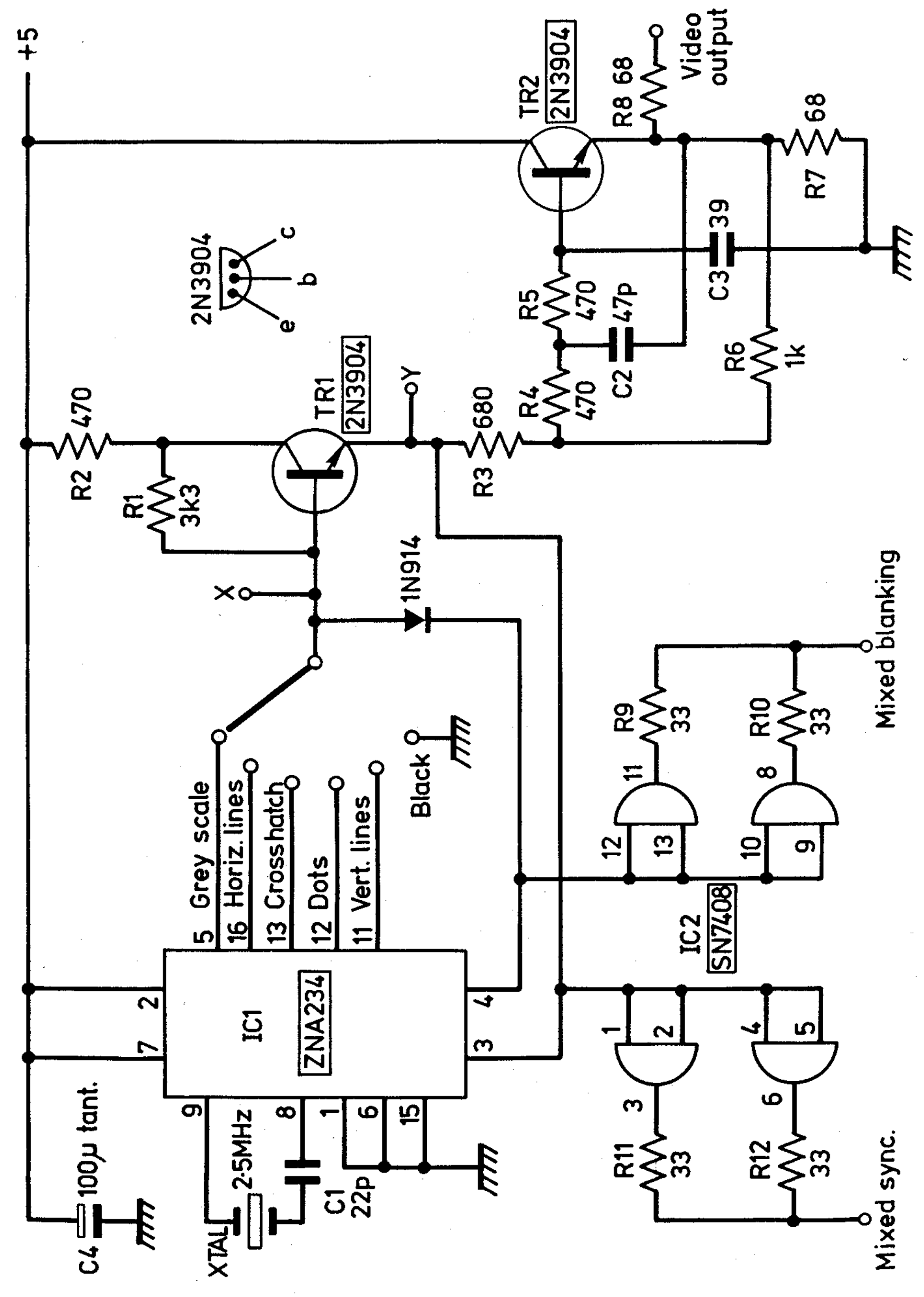


Fig.1: ZNA 234 Monochrome Pattern Generator

Rainbow Electronic Callsign Generator

This is the last of our video sources and perhaps the most complex. Rainbow is a callsign generator that will generate your callsign (up to six characters vertically down the left hand side of the screen). The actual characters can be selected by a simple diode matrix. The generator has two outputs, TTL RGB and composite video. It will drive your transmitter direct, or via the composite video switcher in black and white from the composite video output. From the TTL RGB output it will drive the PAL coder direct, or via the RGB sub switcher. If the colour output is used then the back-ground can be switched to be either white or black. The colour output has each character in a different colour (Rainbow).

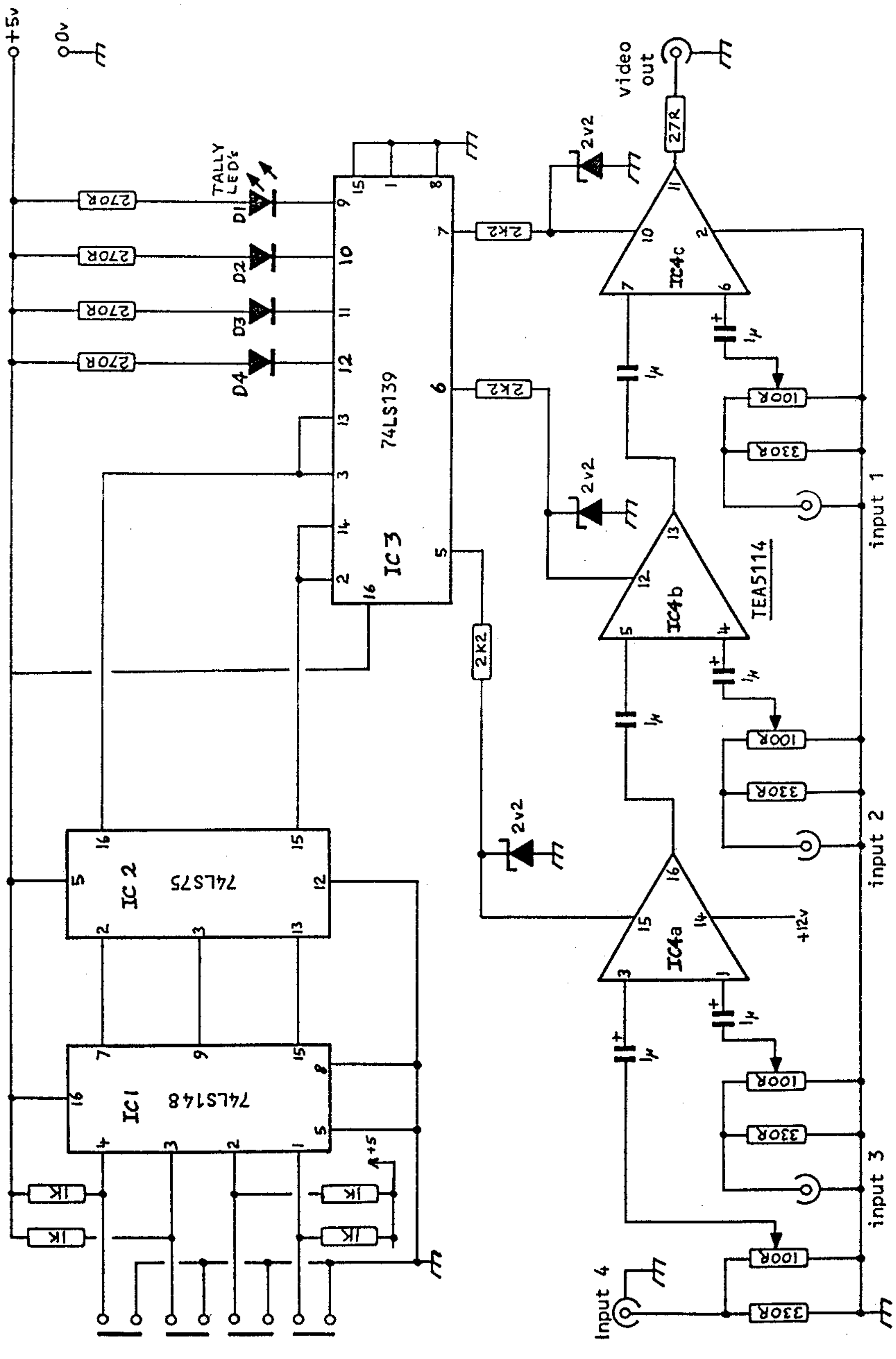


Fig.2: Four-Input Vision Switcher

Rainbow needs a supply of mixed sync and mixed blanking, it will not function without both. The sync and blanking inputs are terminated in 75 ohms, so if you want to run both rainbow and the colour bar generator from the sync and blanking outputs of the pattern generator, then the 75 ohm resistors can be removed, so that the pulses can be daisy chained to both units in the same way that video was daisy chained earlier, the last unit in the chain being terminated in 75 ohms. The whole unit runs from +5 volts which needs to be derived from a well regulated supply such as is provided by an LM7805.

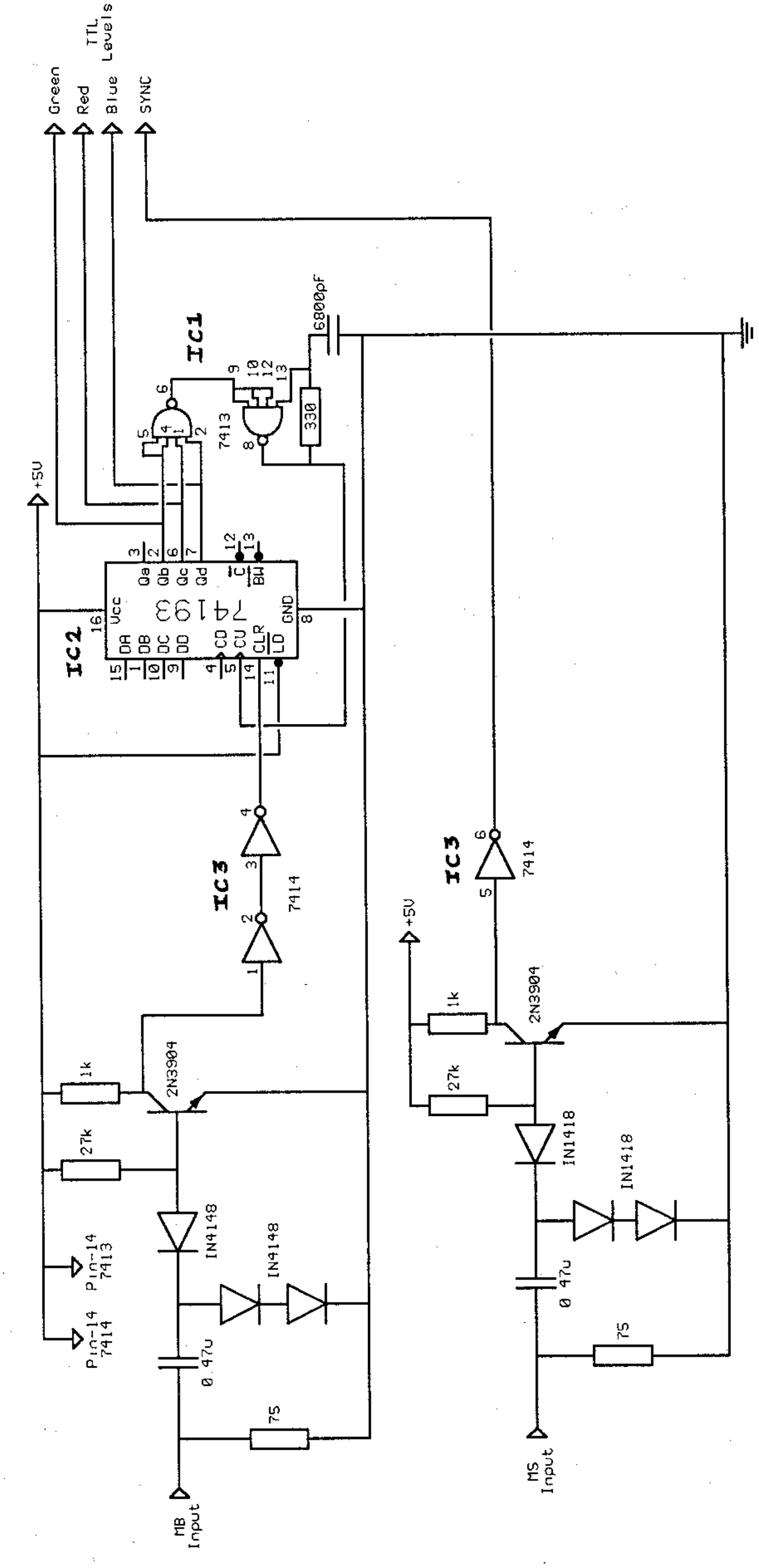


Fig.3: TTL RGB Colour Bar Generator

IC5 is a preprogrammed EPROM, which must be bought from the address in appendix F. It is programmed with all the character fonts and these can be selected via the diode matrix as shown in Fig.6.

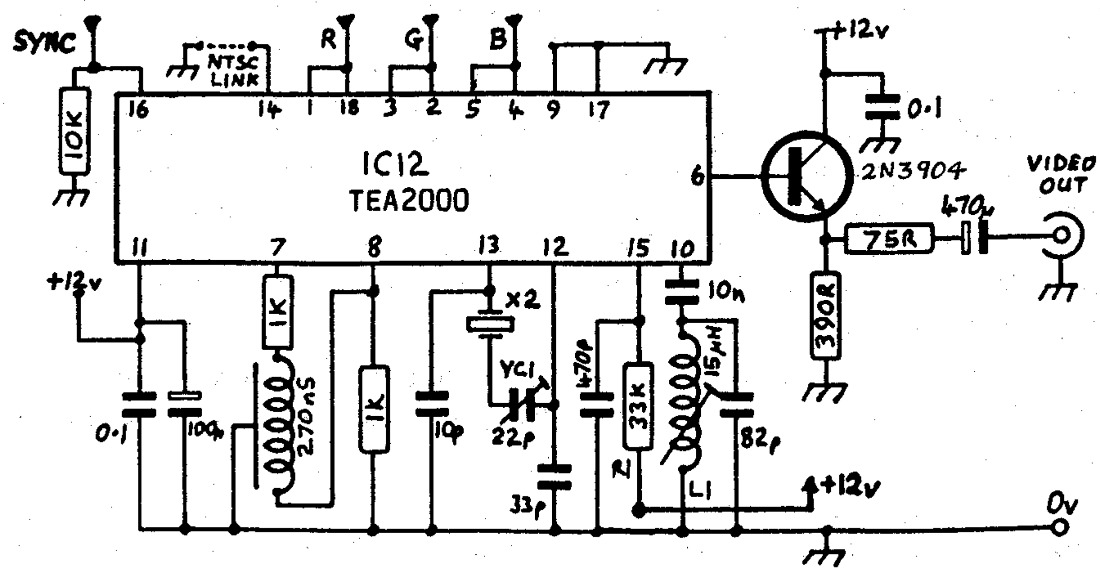


Fig.4: PAL/NTSC Colour Coder

The circuit of the unit is shown in Fig.5. IC1 is a quad two-input nand gate, one of the gates is configured as an oscillator by use of a 1k2 resistor and 100pF capacitor. The oscillator clocks IC2, a dual 4-bit counter, configured as a single 8-bit counter. IC3 counts to sixteen and then stops the oscillator. Line sync pulses are used to reset IC3 so that the count is repeated on every line. This stop and start is necessary, so as to present the same position and phase of count on every TV line. The first count of 0 to 7 is not used, and to this end IC4 is blanked out by its strobe input. On the count of 8 to 15, IC4 is enabled and the data in the top of the EPROM is clocked out as the top row of our first character. The reason for generating the characters twice and blanking out the first one, is purely to put them in a better screen position, not too near the edge of screen.

```
........
........
........
.******.
*......*
*......*
*.......
*.......
*..****.
*......*
*......*
.*****..
........
........
........
........
```

IC6 is another dual 4-bit counter cascaded to act as a single 8-bit counter. This counter is clocked with line sync pulses and advances the address bus of the EPROM to present the second row of the character to IC4. As the TV raster progresses down the screen, so the row address of the character is advanced until all sixteen rows have been clocked out. Then IC6 steps IC7 along. IC7 is a decoder for the three most significant bits of IC6. Every time the character row count passes sixteen, IC7 steps along presenting a logic 0 to its next output. The first output of IC7 blanks out the first scan of the character EPROM, as this character position is too near the top of the screen. Each successive output steps along the diode matrix, enabling a different address to be presented to the higher order address lines of the character EPROM.

This enables us to control the character EPROMs address bus, so as to set which part of the EPROM is displayed for each character position. When IC6 has scanned the last character, it disables the nand gate through which the clock pulses that are advancing it are coming. IC6 is reset at the end of the field scan by two of the gates in IC9 working in conjunction with a 0.03uF capacitor as an integrator, to separate the TV frame information from the incoming sync.

Because IC3 and IC6 are ripple counters, the data from IC4 needs to be cleaned up to remove glitches caused by these counters. This is done in IC2, which is a data latch that is clocked by the original clock oscillator and will remove any glitches.

The RGB colour output is via IC8, which is used to switch three output lines between two sets of inputs. One set of inputs control the background and the other set the foreground. The character data switches IC8 between the two. The back-ground inputs are switched to either logic 1 or logic 0, so as to present either a white or black background, but if you are inventive you can change this by switching some of the inputs independently between ground and +5, and so generate coloured backgrounds.

The foreground inputs are fed with the character address information and so will present a different colour for each character (Rainbow). These can be crossed over to change the sequence of colours, or they can be disconnected from IC7, so all the characters will all be the same colour, which can be selected by grounding some of them.

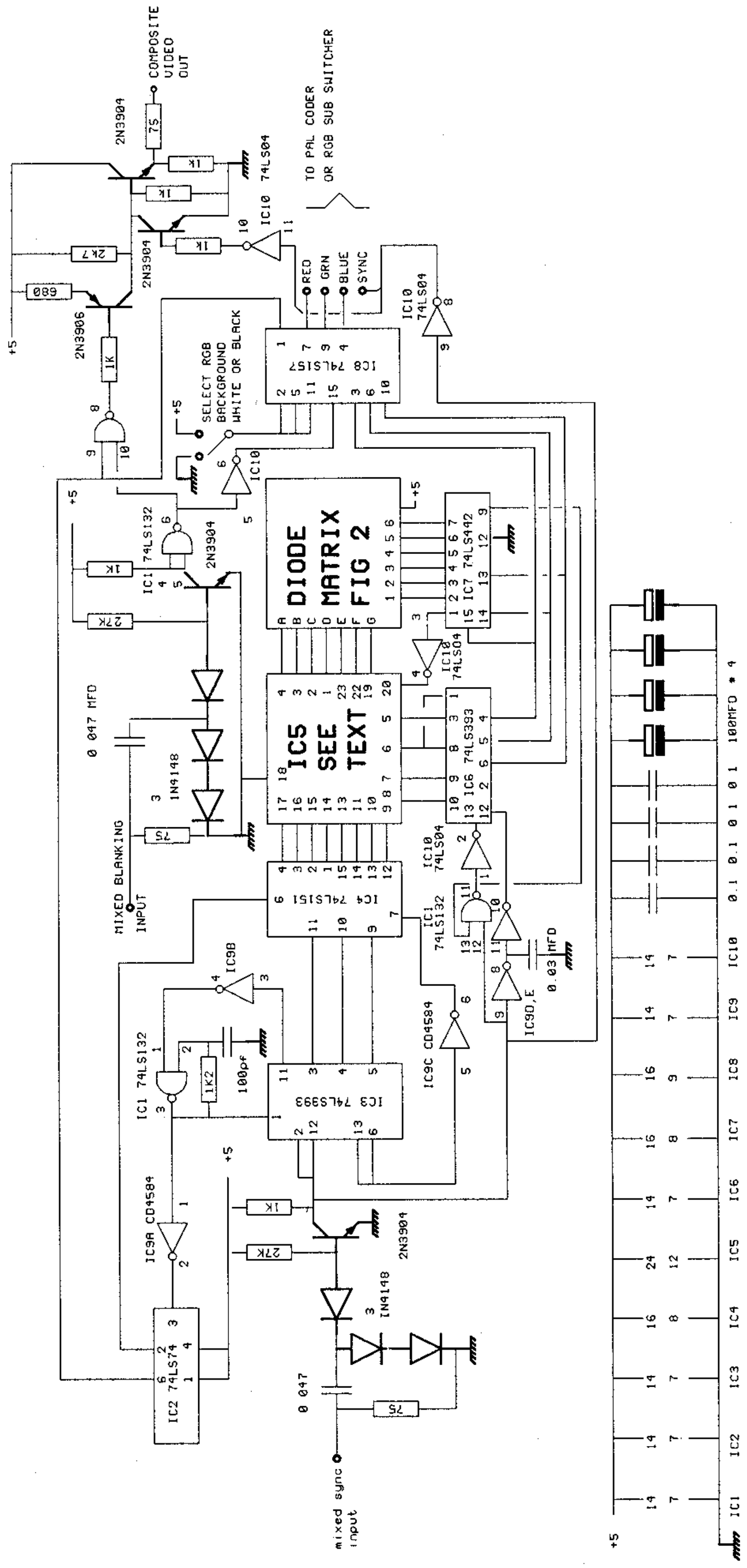


Fig.5: Rainbow Electronic Callsign Generator

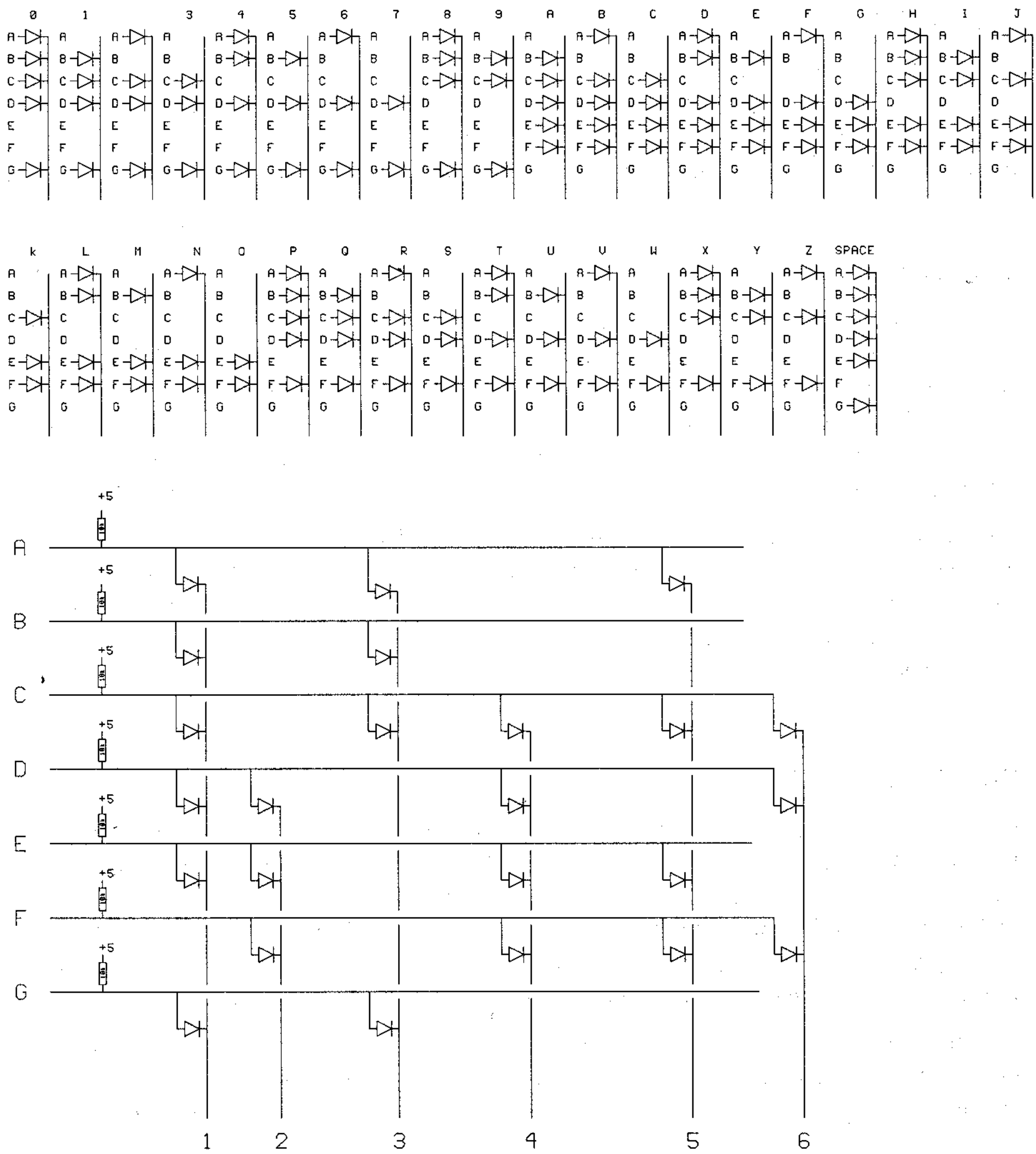


Fig.6: The Diode Matrix for the Rainbow Electronic Callsign Generator

Mixed blanking is used to disable IC8 and ensure colours are not passed, except during active picture lines on the colour output. The same also goes for the non-composite output where a nand gate is used to blank out the input to the composite video output stage.

Fig.6 shows how to programme the diode matrix. the A, B, C, D, E and F, lines are pulled up by 10k pull-up resistors. The diode array for each character is shown, the diode anodes go to the A to G lines and the cathodes are all joined together and taken to the output line that corresponds to the character screen position. Fig.6 shows the matrix wired with blank first and then G8CJS.

The circuit is very flexible and requires no set up or adjustments. The 100 pF capacitor can be varied in value to widen or narrow the characters. The background and foreground can be reversed by using pin-5 of IC2 instead of pin-6 to switch the RGB output between background and foreground thus producing some interesting back-grounds.

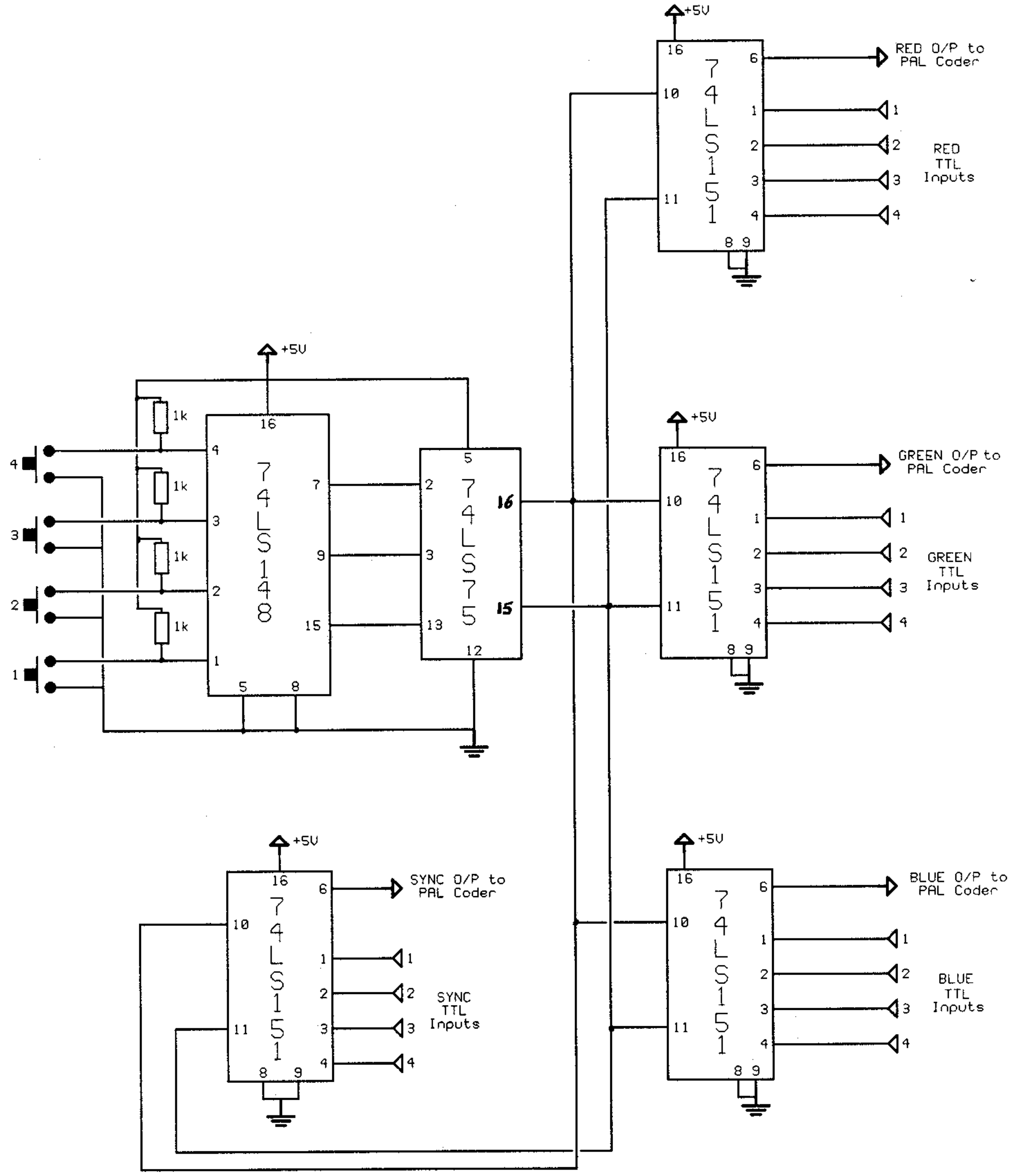


Fig.7: TTL RGB Switcher

TTL RGB Switcher

Most colour TV patterns are first generated as an RGB waveform. They are often TTL RGB as was the case with the colour bar generator. TTL RGB means that they are logic level signals with no intermediate states, just logic levels of 1 and 0. To convert such a signal to PAL or NTSC we need a colour encoder such as shown in Fig.4. The more of these sources we have then the more colour encoders we will require. Fig.7 shows an alternative idea, and that is a TTL RGB switcher, so that one colour coder can be switched to different inputs.

The output of the PAL encoder is composite video and as such could be used as an input to the composite video switcher in Fig.2, or go direct to an ATV transmitter, or colour monitor, or a daisy chain of equipment. The only disadvantage to this system is that only the source selected can be monitored, but as most ATV stations are never over endowed with monitors this may not be a problem.

Fade-To-Black

The block diagram in Fig.9 shows one suggested way in which the TTL RGB Video Switch, the Composite Video Switch, the Pal Coder and the Fade-To-Black unit can be interconnected in your ATV station to provide you with the means to switch any type of video source through to the transmitter.

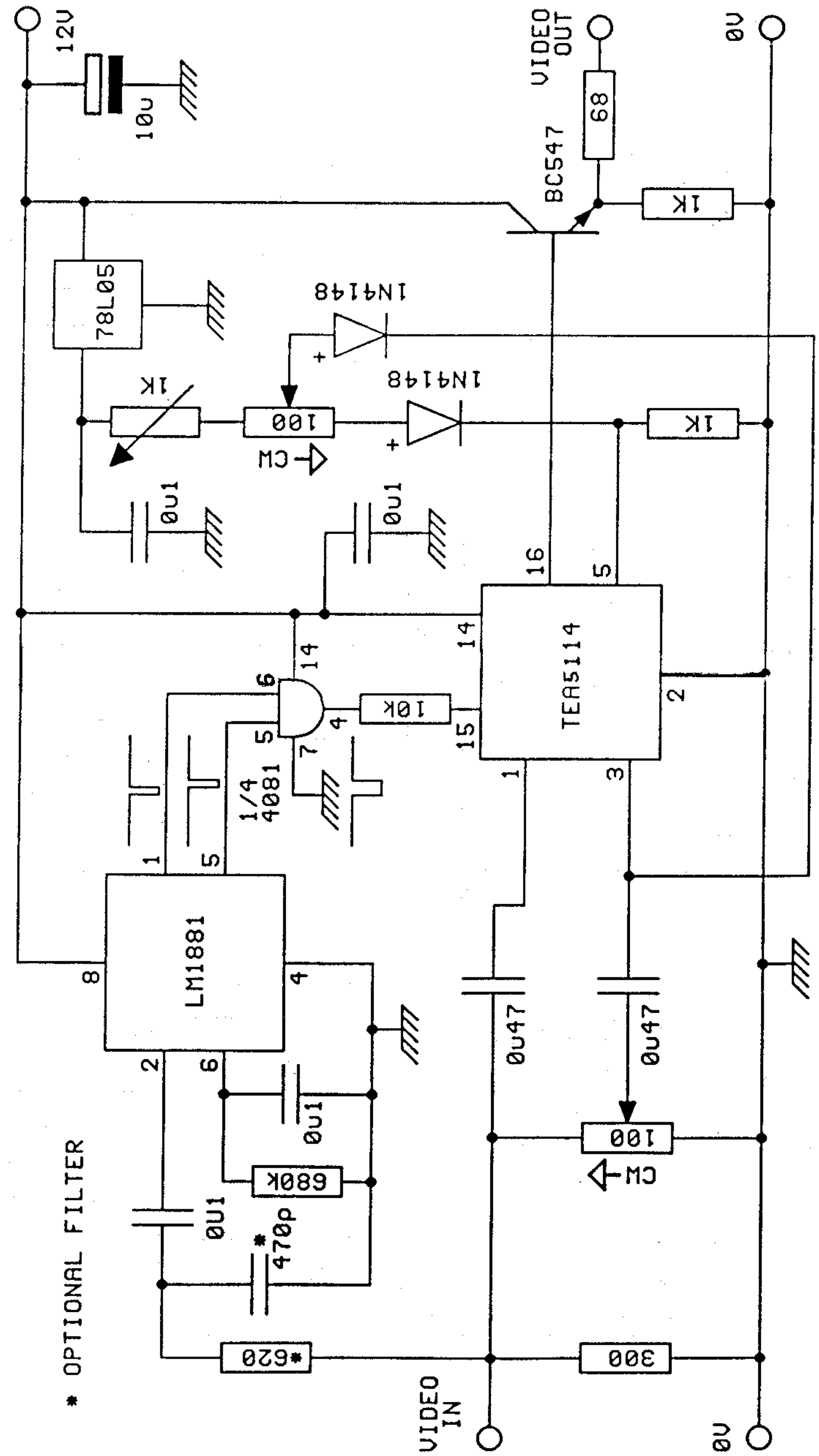


Fig.8: Fade-To-Black circuit

Computers as Video Sources

Once we start playing with video we start looking for additional video sources to use and it is not long before we turn our attention to home computers. We have selected some of the more popular models at various price ranges, and looked at them as video sources.

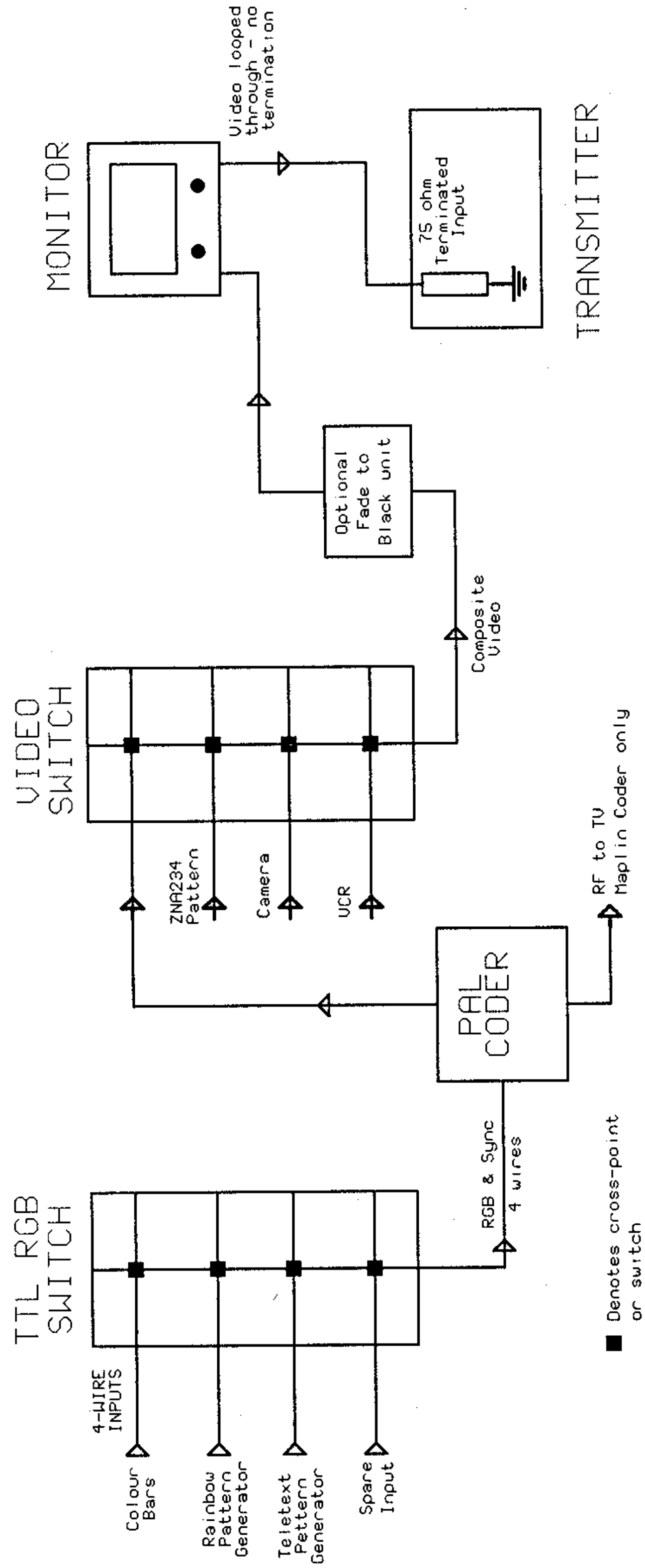


Fig.9: Block Diagram of interconnections between the various video units

Sinclair Spectrum

This is probably not the most idealy suited computer for ATV, but it is available at such attractive prices that its worth adding some hardware to it to overcome some of its short comings. The advantages along with price are the ease at which software can be written for it using its own resident basic language. Some very exciting commercial software packages such as Superintro II, Protitler or Videomaster are available at very reasonable prices for this machine.

Early versions of this computer have only an RF output suitable for connecting to the aerial socket of a TV set. The 1 volt video signal that we require is not available on this early version without the following simple internal modification.

Remove the screws on the underside of the Spectrum and lift off the top to reveal the insides of the computer.

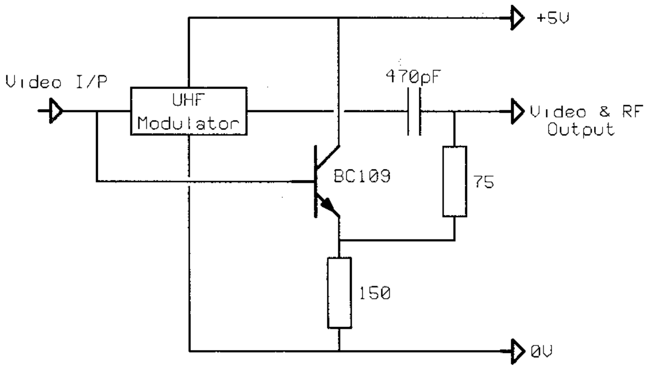


Fig.10: Spectrum Video modification circuit

NOTE: care must be taken pulling out the Keyboard ribbons from their connectors. These connectors are prone to poor connections and thus causing keyboard problems, so take care.

At the rear left hand corner is located the video modulator, easily identified by the RF output phono socket that is part of this module. The video signal is present on the centre connection to the modulator and the input to the emitter follower circuit shown in Fig.10 must be connected to this point to buffer the composite video signal for connection to the outside world. The +5 volts required to power the emitter follower is also available on the other connection of this module.

Now comes the really clever bit to save adding a further socket to the computer to carry the video signal. Open up the modulator and insert a 470pf capacitor in the lead from the modulator circuit board to the phono socket centre pin. This capacitor acts as a DC block between the phono socket and the modulator. Now the emitter of our additional buffer circuit in Fig.10 can be connected to the phono socket on the socket side of the 470pF capacitor just inserted, via the 75 ohm build up resistor. There is even a spare hole in the metal body of the modulator next to the video connection to take the resistor through.

This modification now makes not only video, but also RF, available at the phono socket, so your Spectrum can be used to drive a TV, or to provide a 1 volt composite video signal from the same phono socket.

The unfortunate thing about the Spectrum, is that as yet there is no way of superimposing the video signal onto any other video source. The best solution, if this is the way you want to go, is a more expensive computer such as the Amiga or Atari ST range.

The BBC

Although like the Spectrum the BBC is now an outdated machine, it is still available at quite attractive second-hand prices and there is still a lot of software around for the machine that is suitable for ATV use. Again, like the Spectrum, the BBC is easily programmed with its own Basic language and some simple, but pleasing, colour patterns and test cards can be produced.

The two BBC Basic program listings overleaf will provide two useful ATV pictures; in listing one a colour test card with call sign insert, and in listing two a colour bar test pattern. Both programs can be easily modified with your own ideas.

```
10 ON ERROR GOTO 430
20 REM call sign must have no more than 8 characters
30 A$=”G8NVS’
40 g%=(640-(LEN A$*30))
50 c%=5:n%=10
60 IF LEN A$<6 c%=6:n%=9
70 IF LEN A$=8 c%=4:n%=11
80 MODE 2
90 VDU 23,1,0;0;0;0;
100 PROCGREY
110 GCOL 0,0:MOVE 0,1008:MOVE 0,1024:PLOT 85,1280,1008:PLOT 85,1280,1024
120 GCOL 0,7
130 FOR I%=0 TO 1280 STEP 80
140 IF I%>=480 AND I%<=800 THEN MOVE I%,0:DRAW I%,224:MOVE I%,336:DRAW I%,1008
ELSE MOVE I%,0:DRAW I%,1008
150 NEXT
160 FOR I%=0 TO 1008 STEP 56
170 IF I%=280 THEN MOVE 0,I%:DRAW 480,I%:MOVE 800,I%:DRAW 1280,I% ELSE MOVE
0,I%:DRAW 1280,I%
```

```
180 NEXT
190 FOR I%=0 TO 15:READ D%:PROCRECT(I%,17,D%):NEXT
200 FOR I%=0 TO 15:READ D%:PROCRECT(I%,0,D%):NEXT
210 FOR I%=0 TO 17:READ D%:PROCRECT(0,I%,D%):NEXT
220 FOR I%=0 TO 17:READ D%:PROCRECT(15,I%,D%):NEXT
230 FOR I%=5 TO 10:READ D%:PROCRECT(I%,15,D%):NEXT
240 FOR I%=2 TO 13:READ D%:PROCRECT(I%,14,D%):NEXT
250 FOR I%=2 TO 13:READ D%:PROCRECT(I%,13,D%):NEXT
260 FOR I%=2 TO 13:READ D%:PROCRECT(I%,11,D%):NEXT
270 FOR I%=2 TO 13:READ D%:PROCRECT(I%,10,D%):NEXT
280 FOR I%=2 TO 13:PROCRECT(I%,7,0):NEXT
290 FOR I%=2 TO 13:PROCRECT(I%,6,0):NEXT
300 FOR I%=2 TO 5:PROCRECT(I%,5,0):NEXT
310 FOR I%=2 TO 5:PROCRECT(I%,4,0):NEXT
320 FOR I%=10 TO 13:PROCRECT(I%,5,7):NEXT
330 FOR I%=10 TO 13:PROCRECT(I%,4,7):NEXT
340 FOR I%=c% TO n%:PROCRECT(I%,3,4):NEXT
350 FOR I%=C% TO n%:PROCRECT(I%,2,4):NEXT
360 VDU 26
370 VDU 5:GCOL 0,7:MOVE g%,180:PRINT A$
380 PROCstripe(2,5,20)
390 PROCstripe(6,5,16)
400 PROCstripe(10,5,8)
410 GCOL 0,7:MOVE 520,728:DRAW 520,840
420 A%=GET
430 VDU 23,1,1;0;0;0;:MODE 7:END
440 DEF PROCRECT(A%,B%,C%)
450 GCOL 0,C%
460 A%=A%*80:B%=B%*56
470 MOVE A%,B%:MOVE A%,B%+56:PLOT 85,A%+80,B%:PLOT 85,A%+80,B%+56480 ENDPROC
490 DEF PROCstripe(M%,N%,O%)
500 V%=7:M%=M%*80
510 FOR G%=M% TO M%+312 STEP O%
520 IF V%=0 THEN V%=7 ELSE V%=0
530 GCOL 0,V%
540 MOVE G%,340:MOVEG%,446:PLOT 85,G%+O%,340:PLOT 85,G%+O%,446
550 NEXT
560 ENDPROC
570 DEF PROCGREY
580 FOR K%=0 TO 2 STEP 2
590 P%=&2A00
600 [OPTK%
610 .GREY LDA£0:STA&75
620 LDA£&30:STA&76
630 .A LDY£0
640 .B LDA£42:STA (&75),Y
650 INY
660 LDA£21:STA (&75),Y
670 INY
680 CPY£0:BNE B
690 INC&76
700 LDA&76
710 CMP£&80
720 BNE A
730 RTS:]
740 NEXT
750 CALL &2A00
760 ENDPROC
770 DATA 7,0,6,0,6,0,6,0,0,6,0,6,0,6,0,7,7,0,2,0,2,0,2,0,0,2,0,2,0,2,0,7,7,0,4
780 DATA 0,4,0,4,4,0,0,1,1,0,1,0,1,0,7,7,0,3,3,0,7,7,0,0,0,0,7,7,0,3,3,0,7,3,3,1,1,3,3,7,7,7,
7,0,0,0,0,7,7,7,7,7,7,7,7,0,0,0,0,7,7,7,7,3,3,6,6,2,2,5,5,1,1,4,4,3,3,6,6,2,2,5,5,1,1,4,4
```

BBC Listing 1: Test Card with Call sign

```
1 REM****** PROGRAM -- COLOUR BARS (GREY SCALE B/W)
2 REM****** WITH CIRCLE
3 REM THE SIZE OF THE CIRCLE CAN BE CHANGED BY ALTERING THE
4 REM STEP AND THE NUMBER OF TIMES THE ‘FOR/NEXT’ LOOP IS DONE
8 REM******PROGRAM DE EI7GM-DUBLIN
10 MODE 2: GCOL 0,0:MOVE 0,500:PLOT 85,150,1000:PLOT 85,160,500:GCOL 0,4:PLOT 85,300,1000:PLOT 85,300,500:GCOL 0,1:PLOT 85,450,1000:PLOT 85,450,500:GCOL 0,5:PLOT 85,600,1000:PLOT 85,600,600
20 GCOL 0,2:PLOT 85,750,1000:PLOT85,750,500,GCOL 0,6:PLOT 85,900,1000:PLOT 85,900,500:GCOL 0,3:PLOT 85,1050,1000:PLOT 85,1050,500:GCOL 0,7:PLOT 85,1200,1000:PLOT 85,1200,500
30 MOVE 0,500:MOVE 0,0:PLOT 85,150,500:PLOT 85,150,0:GCOL 0,3:PLOT85,300,500:PLOT 85,300,0:GCOL 0,6:PLOT 85,450,500:PLOT 85,450,0:GCOL 0,2:PLOT 85,600,500:PLOT85,600,0
40 GCOL 0,5:PLOT 85,750,500:PLOT 85,750,0:GCOL 0,1:PLOT 85,900,500:PLOT 85,900,0:GCOL 0,4:PLOT 85,1050,500:PLOT 85,1050,0:GCOL 0,0:PLOT 85,1200,500:PLOT 85,1200,0
50 VDU 31,0,31:GCOL 0,7:MOVE 0,0:DRAW 1200,0:DRAW 1200,1000:DRAW 0,1000:DRAW 0,0
60 SC=444:REM (----------- ‘‘SC”
70 ox=600:oy=500:MOVE 1044,500
80 FOR R=0 TO 54 STEP 4:REM (=========== ‘‘RESOL”
90 x=COSr:y=SINr:rx=x^SC:ry=y^SC:x=x+rx:y=y+ry:x=ox+rx:y=oy-ry:DRAW x,y:NEXT
100 D=GET:RUN
```

BBC Listing 2: Colour Bars

Colour from the BBC

A sometimes surprising aspect of the BBC series of computers is that the standard composite video output from the machine is in monochrome and not colour. However, a simple internal modification is all that is required to overcome this and turn the composite video output into a full colour signal.

The modification entails adding a 56pF capacitor between the emitter of Q9 and the base of Q7, thus adding the colour burst signal to the output video waveform. It is possible to add this capacitor to the component side of the printed circuit board, thus removing the necessity to completely disassemble the computer.

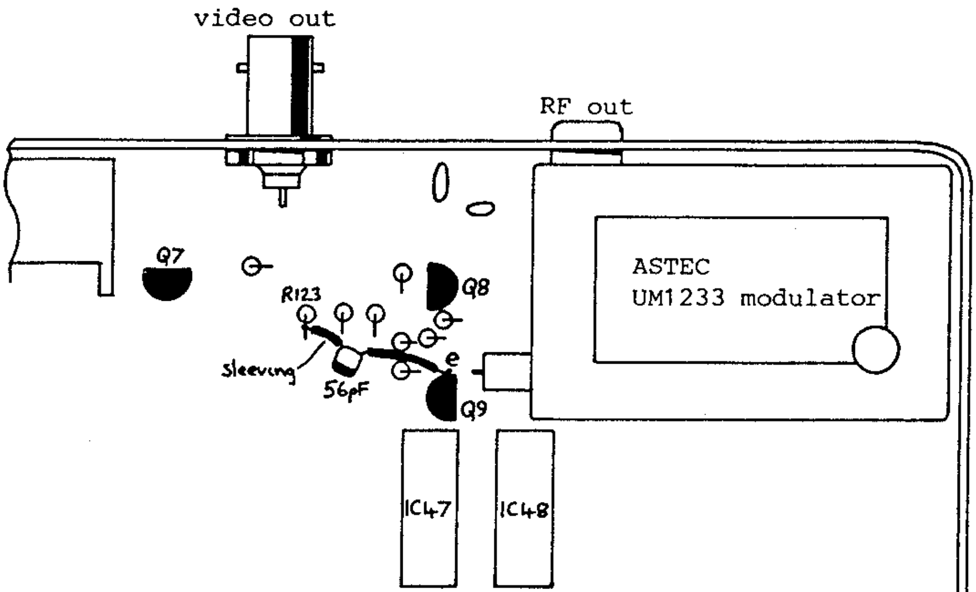


Fig.3: Location of the Colour Modification for the BBC

The layout of the computer printed circuit board in the area of the modification is shown in Fig.x. This area is in the rear right-hand corner, adjacent to the video output socket and the RF modulator.

The modification capacitor should have its legs protected with lengths of sleeving to prevent short circuits. One leg should be soldered carefully to the emitter of Q9, whilst the other should be connected to the top of the 470 ohm resistor, R123, which stands up off the board in the position shown.

That completes the modification and the computer will now have a full colour composite video signal available on the video output socket.

The Worthing and District Video Repeater Group market their ‘BBC Amateur Television Program’, which includes several test card patterns, a message pad and a Maidenhead locator system amongst other facilities.

The Commodore Amiga

This is without doubt the most suitable computer for TV video work, ITV’s ‘‘The Chart Show” uses one for their captions. However, the power of the Amiga is unfortunately reflected in its price.

The biggest single advantage of this computer is that, with the addition of commercially available genlock units, it can superimpose its output onto an existing video source. The genlock units are not cheap, starting with the Mini Genlock at around £100. This unit enables the Amiga to superimpose captions onto an existing video source, but not to superimpose an existing video source onto the Amiga, i.e: the Amiga is always the foreground and can not become the background. The Mini Genlock is also limited in adjustments. Line timings are not adjustable and this can be a problem in some circumstances.

The next genlock up is the Rendale and this unit has line timing adjustments and enables the Amiga to perform background or foreground video. As you would expect, the Rendale is more expensive and weighs in at £199.99.

The genlock units not only enable superimposition work, but provide a composite PAL signal. Without a genlock unit fitted the Amiga produces only RGB signals.

If you really want to go mad, the GST Gold Pro YC genlock weighs in at £649.99. This unit will enable you to work at Y-C, the separate signals used by S VHS and Hi8, and also to perform fades. There is also adjustment of horizontal position and phase.

The ultimate genlock must be the Videocentre Plus G2 System at £1169. This has three faders, one for fade to black, one for cross fades between the Amiga and a video image, and one to vary the size of wipes and patterns. To complement this very powerful piece of TV hardware is a range of Software that will give all the creative control you could ever wish for.

The Atari ST

The Atari ST range of computers is also an excellent choice for ATV work. The graphic displays available on this machine are also of a very high standard, although it must be said that the Amiga has the edge.

The output from the Atari is available as either RGB or composite video. However, a small modification has to be made in order to utilise the composite output if a monitor is still to be connected (somewhat useful if you still wish to monitor the picture!).

The simple emitter follower buffer circuit shown in Fi.11 can be built onto a piece of Veroboard and fixed inside the Atari. The computer has to be disassembled, which itself is something of a mammoth task. Firstly take off the top cover by removing the screws from the bottom of the computer. Then remove all the screws securing the metal screen to the bottom case, release the metal locating tags and lift off the screen. Locate the small PCB in a convenient position and make the connections shown in Fig11 to the `Monitor' socket at the rear of the computer. A socket for the composite video output from the modification board can be fitted in the rear case adjacent to the TV RF socket, or if the computer is not an `FM' model, a socket can be fitted where the TV socket would be.

The connections to the PCB are as shown below:

VIDEO INPUT ...... PIN-2 MONITOR SOCKET

+12 VOLTS .... PIN-8 MONITOR SOCKET

GROUND/0V .... PIN-13 MONITOR SOCKET

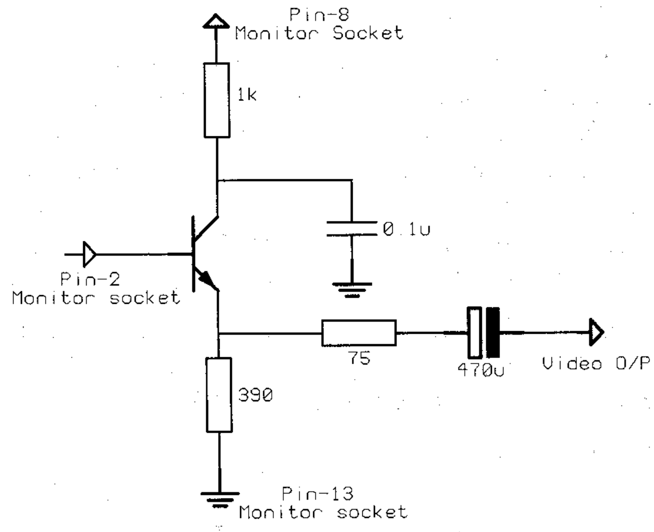


Fig.11: Atari ST Video modification circuit

Unfortunately, it is not possible to similarly modify the MEGA ST range of Atari computers as they have no internal circuitry to provide a composite video signal. Instead, an RGB-to-CVBS converter must be used.

There is not a great deal of commercially written software for the Atari specifically aimed at ATV, although a suite of programs is available from KM Publications, which offers several colour bar screens, a test card, Maidenhead locator system, contest number screens and a contest score calculating routine amongst others.

The PC

The problem with this very powerful computer is that the only colour signal available is RGB and not 625 lines. The line speed for 625 line television is 15.625 kHz. However, the PC works on number of video standards; CGA, where the line speed is of the order of 18kHz, EGA, which works at 24kHz and VGA, which works at 31.5 kHz or higher. Hardware is starting to appear for genlocking the PC's. The EGA system can be genlocked for as little as £125 and the VGA for £595.

A 70cm Amateur Television Station

The 70cm band is where amateur television started. Back in the 1950s there were one or two stations working special /T licences working ATV with wholly home-built equipment. Everything from the cameras to the aerials were constructed by these entrepreneurial amateurs, who paved the way and brought many innovations to this aspect of amateur radio. Nowadays, there are very many 'seventysentimentalists' working ATV on 70cm and it is an ideal starting point for anyone wishing to enter this fascinating world of ATV

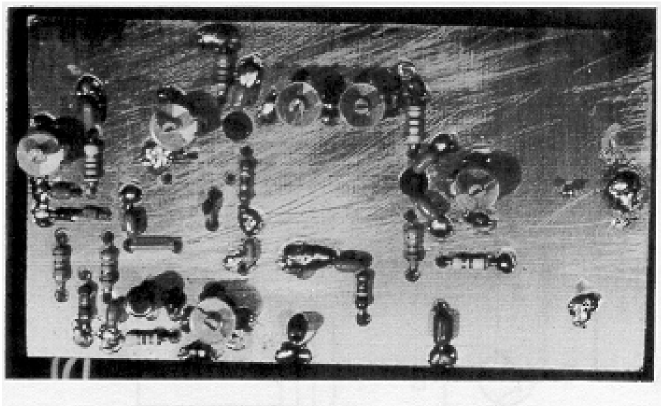
This chapter includes two projects, a 70cm downconverter for receiving amateur TV signals and displaying them on a standard TV set, an RF preamplifier for enhancing the performance of the downconverter, and a 5 Watt ATV transmitter. These three units will form the basis of a 70cm ATV station, the only additions being a video source from chapter 4 (or wherever), a standard TV set and an aerial. The downconverter and transmitter projects will feature ready-made printed circuit boards which are available from BATC Members' Services (Appendix F).

A 70cm Down Converter

The 70cm downconverter described here is a new design which features good sensitivity and intermodulation characteristics. Incorporated in input circuitry of the unit is a stripline band-pass filter, tuned to the 70cm band, to reduce out-of-band signals. An output bandpass filter is also included in the design, to reduce the unwanted images and local oscillator signals to a minimum. The input of the converter is tuned to match an impedance of 50 ohms for direct connection to an aerial feeder or preamplifier output, and the output impedance of the unit is matched to 75 ohms for direct connection to a television set aerial input socket.

The local oscillator is a conventional varicap tuned circuit (Q3), which allows the use of a remote tuning control in the form of a 10k potentiometer (VR1). A remote IF gain control can also be fitted if desired (VR2).

The circuit diagram of the downconverter is shown in Fig.1. The unit is extremely simple to build and align, there being no inductors to manufacture and align, and very stable operation is achieved from a 12 to 15 volt supply at approximately 50 mA. The conversion gain of the unit has been restricted to around 8dB, to ensure that no unwanted spurious signals are generated in the input amplifier stage (Q1) caused by the transistor breaking into self-oscillation.



A prototype 70cm Downconverter

Construction

A printed circuit board is available from Members' Services for this project so a PCB layout and component overlay has not been included here.

Transistors Q1 and Q2 are mounted through the PCB, so 0.25 inch holes will need to be drilled through the circuit board at the centre-points of each location, indicated by circles of unetched copper. The two transistors should be mounted with their numbered sides on the circuit side of the board, not the ground-plane side. The screen connection of Q3 is not required and should be cut off at the case.

All the through connections to the ground-plane side of the board are effected by plated-through-holes, so now wire links are necessary, thus making the construction less time-consuming. However, a short insulated 22 SWG wire link from the centre of L6 to the junction of C16, R11 and ZD1 will need to be fitted.

The varicap diode CD1 is formed from a BC182L transistor. Join the transistor's emitter and collector together and connect them to the junction of C15 and R8. The base connection of the transistor is connected to 0 volts.

If a remote IF gain control is not required, VR2 should be omitted and a wire link soldered in its place. The input and output coaxial cables' (50 ohm impedance for the input, 75 Ohm impedance for the output) screen connections should be soldered to the ground-plane and the inner conductors soldered to their relevant connections, keeping the exposed inner conductors as short as possible.

The unit should be mounted in a metal box for screening, with BNC sockets for connecting the inputs and outputs. A reversed-biassed diode should be incorporated at the power input as shown in Fig.2, for precaution against reverse connection of the supply voltage.

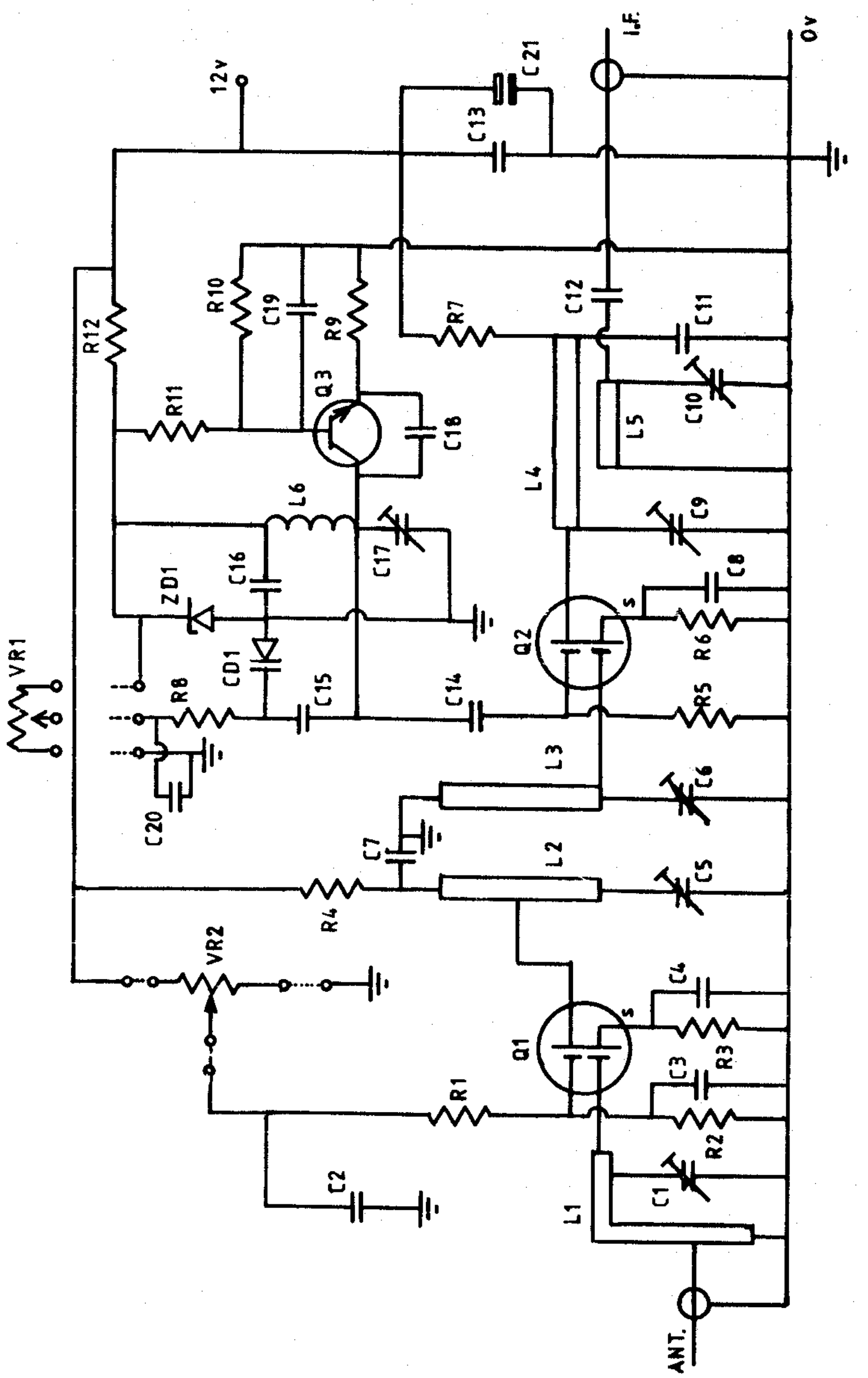


Fig.1: The 70cm Downconverter

Parts List

Resistors		Capacitors	
R1	22k	C1	1.8 – 10pF Sub Min Trimmer
R2	39k	C2	10nF mono ceramic radial 2.54 pitch
R3	100	C3	1nF mono ceramic radial 2.54 pitch
R4	390	C4	1nF mono ceramic radial 2.54 pitch
R5	100k	C5	1.8 – 10pF Sub Min Trimmer
R6	100	C6	1.8 – 10pF Sub Min Trimmer
R7	220	C7	1nF mono ceramic radial 2.54 pitch
R8	100k	C8	1nF mono ceramic radial 2.54 pitch
R9	270	C9	1.8 – 10pF Sub Min Trimmer
R10	2k7	C10	1.8 – 10pF Sub Min Trimmer
R11	10k	C11	1nF mono ceramic radial 2.54 pitch
R12	100	C12	4p7 Sub min plate ceramic 2.54 pitch
VR1	10k Lin	C13	100nF mono ceramic radial 5.08 pitch
VR2	4k7 Lin	C14	15pF Sub min plate ceramic 5.08 pitch
Inductors		C15	15pF Sub min plate ceramic 5.08 pitch
L1, L2, L3	PCB Microstripline	C16	1nF mono ceramic radial 2.54 pitch
L4, L5	PCB Microstripline	C17	2 – 22pF sub min trimmer
L6	PCB Printed Inductor	C18	4p7 Sub min plate ceramic 2.54 pitch
Active Devices		C19	1nF mono ceramic radial 2.54 pitch
Q1	BF981	C20	10nF mono ceramic radial 2.54 pitch
Q2	BF980 or BF960	C21	10uF 25V radial
Q3	BFY90		
CD1	BC182L (see text)	**Note: mono = monolithic**	
ZD1	10v 400mW		

Alignment

After confirming that all the components have been correctly placed and soldered in and that no solder-bridges are present connect the power. The current drawn should be in the region of 45 to 55mA, dependant on the setting of VR2 if used.

Set C1, C2, C3 and C10 to half mesh and C9 and C17 to one quarter mesh. The oscillator frequency will depend on what output frequency i.e: which TV channel) is required and is calculated as follows:

LOCAL OSCILLATOR FREQUENCY = TV CHANNEL FREQUENCY - 70cm SIGNAL

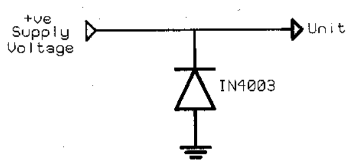


Fig.2: Reverse power protection

The usual TV channel used is 36, as there are no broadcast TV stations on this channel. The frequency of channel 36 in the UK is 591.25MHz, thus for a signal on 435MHz (the centre of the 70cm ATV allocation) the local oscillator frequency must be `591.25 - 435', which gives 156.25MHz. The main local oscillator tuning component is C17, which will allow the frequency to be varied between approximately 150 and 190MHz. Set VR1 to one third clockwise rotation. If a frequency counter is available, loosely couple it to the oscillator by forming a small insulated loop at the end of a piece of cable, by joining the inner conductor and screen together, and dropping the loop over Q3 or C17, and connecting the other end to the counter. Adjust C17 to give a reading of 156.25MHz.

Alternatively, a grid-dip meter may be used to set up the oscillator, by selecting the appropriate coil for the meter and setting the dial for 156-157MHz, and then adjusting C17 for a dip on the meter.

If neither a frequency counter or grid-dip meter are available, then the following method can be used to set the local oscillator reasonably close to the required setting. Tune the TV set to channel 21 and connect a piece of coaxial cable to the aerial socket and loosely couple it to the oscillator section of the converter as above. Adjust C17 until the TV screen `whites-out' due to the presence of the third-harmonic of the local oscillator.

Having set the local oscillator by one of the methods described above connect an aerial to the input of the converter and a TV set to the output tuned to channel 36, whilst receiving a signal from a distant station fine tune the TV set for best picture and then adjust the remaining trimmer capacitors on the converter for the best picture. Repeat the adjustments several times for best results.

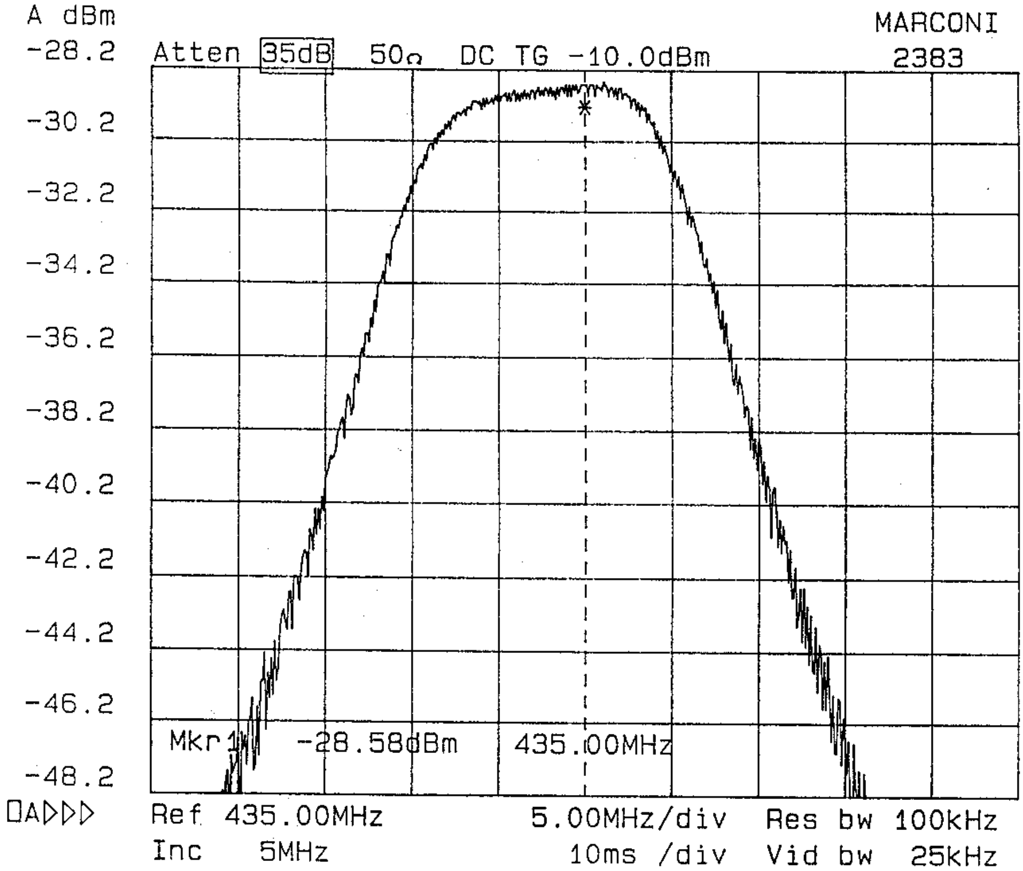


Fig.3: 70cm Downconverter Bandpass Filter response

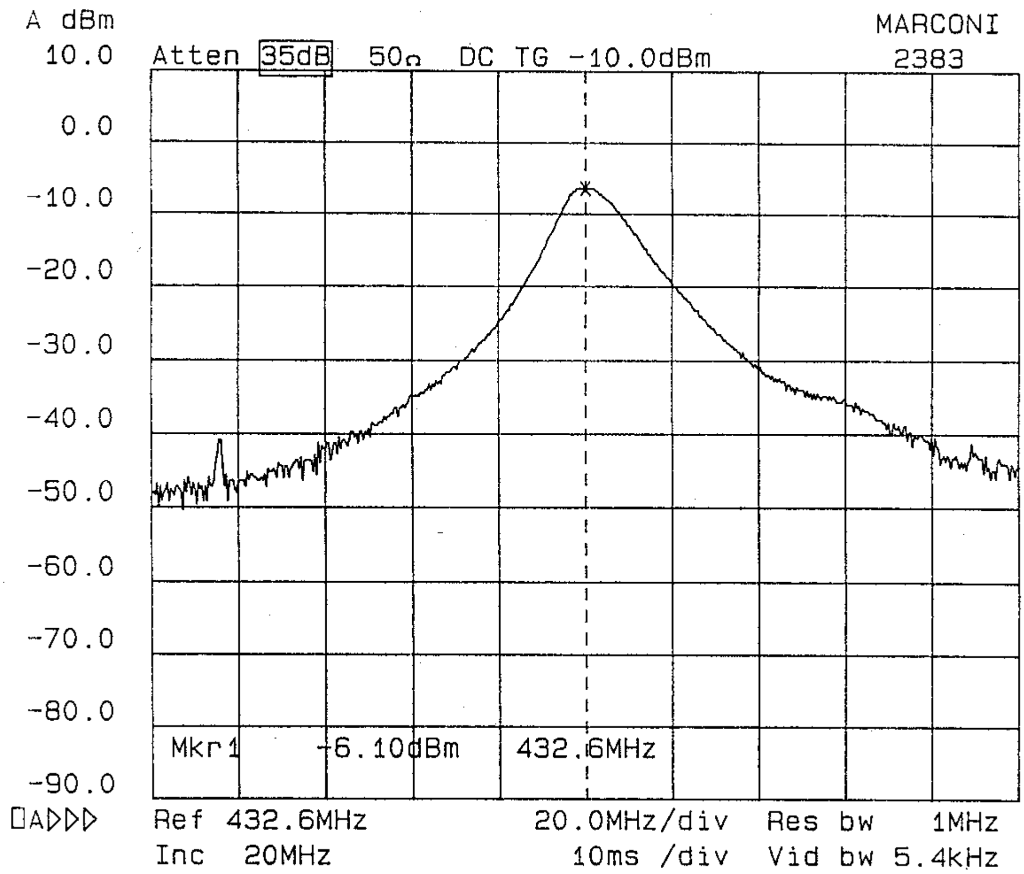


Fig.4: 70cm Downconverter Overall band response

Finally, reduce the received picture strength so that a noisy picture results (an easy way to do this is turn the beam off direction) and then readjust C17 for the strongest picture. You should now have a fully working

70cm downconverter. The plots shown in Fig's.3 and 4 show the input bandpass filter response and the overall response of the unit respectively.

70cm Preamplifier

Although the heading state preamplifier, this section actually describes a dual-preamplifier, the first unit being a single-stage GaAsFET cavity-tuned unit and the second a bipolar wideband preamplifier. The advantage of this system is that the first unit can be mounted in a waterproof housing and situated at the aerial and the second unit mounted at the receiver making up for cable losses.

The GaAsFET Preamplifier

The Gallium Arsenide Field Effect Transistor (GaAsFET) unit features a noise figure of around 0.5dB and the bipolar unit a figure of around 2dB. Although the GaAsFET unit features a very low noise figure it also has very good strong signal performance, with a consequent reduction in noise figure, which makes it ideal for ATV use.

The one major disadvantage of using GaAsFET devices is that they have a very high input impedance, whereas bipolar transistors have input impedances which are relatively close to 50 ohms, typically a few hundred ohms, so they are relatively easy to match into quite narrow or broadband systems. This leaves open the option of fitting narrow, low-loss filters in front of preamplifiers using them.

However, with GaAsFETs the input impedance is in the order of tens of kilohms, so a very high-Q network is necessary to step up the impedance from the input with low loss, and it is consequently difficult to make them operate over a broad bandwidth. This is a disadvantage for many professional applications, but actually a positive benefit for amateur application. It requires the construction of a very narrow bandwidth, low loss, input matching circuit, which will reject out-of-band signals and reduce the number of spurious products generated in the receiver. This is particularly effective since the filter is in front of all the active devices in the receiver. Broadband amplifiers can suffer badly in this respect from the large number of strong signals present in the VHF and UHF bands. This GaAsFET preamplifier has been used in close proximity to quite powerful 2M transmitters with aerials on the same mast without experiencing problems.

Construction

The circuit of the GaAsFET preamplifier is shown in Fig.5 and the layout in Fig.6. The unit is built on double-sided printed circuit board, which is used as a ground-plane. The whole amplifier fits inside a 4.4 x 2.4 x x1.25 inch die-cast box, with the ground-plane replacing the lid. The internal screens are also produced from double-sided PCB for rigidity and ease of soldering. The covers for the input inductor L1 are constructed from thin brass or copper foil.

Firstly, mark out and cut the PCB to fit over the top of the die-cast box and drill the mounting holes in each corner. Mark the position of the posts in the corners of the box on the PCB, so as to avoid mounting anything on the board which will foul them; this is likely to occur if the input socket is mounted too near to the corner of the box.

Solder the three pieces of PCB screen (0.8" high) in place, soldering along both sides of the screens all along their length. Mount the feed-through capacitors in the screen and lid. The capacitor entering the GaAsFETs drain compartment should be about halfway up the screen, and the one into the gate line about 0.2 inches from the top of the screen.

Cut out two small pieces of PCB material about 0.125 inches square as mounting pads for the GaAsFET leads and glue them down flat to the ground-plane on each side of the gap in the screen (cyanoacrylate adhesive is best). Mount the input and output sockets and C2, ensuring that the sockets do not foul the sides of the box. If the sockets that require four mounting holes are used they can be pushed through the PCB from the inside of the box and soldered to the ground-plane on the inside. Single hole fixing sockets can be used in this way or just bolted in. BNC, TNC or SMA sockets are suitable due to their size, whereas N-type sockets are too large.

Adjust the distance by which the input socket protrudes above the PCB, so that C1 can be easily soldered to both C2 and the socket. Next, form the input inductor L1 from some cooper sheet about 0.040 inches thick. Solder the inductor in place, grounded end first and then the end resting on C2. All the remaining components can now be installed. Take care when soldering to the trimmer capacitors, as the top connections can become unsoldered from the body if they get too hot.

A piece of flexible wire, rather than cooper strip, should be used to connect C2 to C3, to prevent any stress being applied to C3. Next, bend up the screen to cover the top, side and end of L1, and solder it in place along all the joints. The screen should stop just at the end of L1, leaving access to both trimmers and the GaAsFET, and be about 0.3 inches above the copper line forming L1.

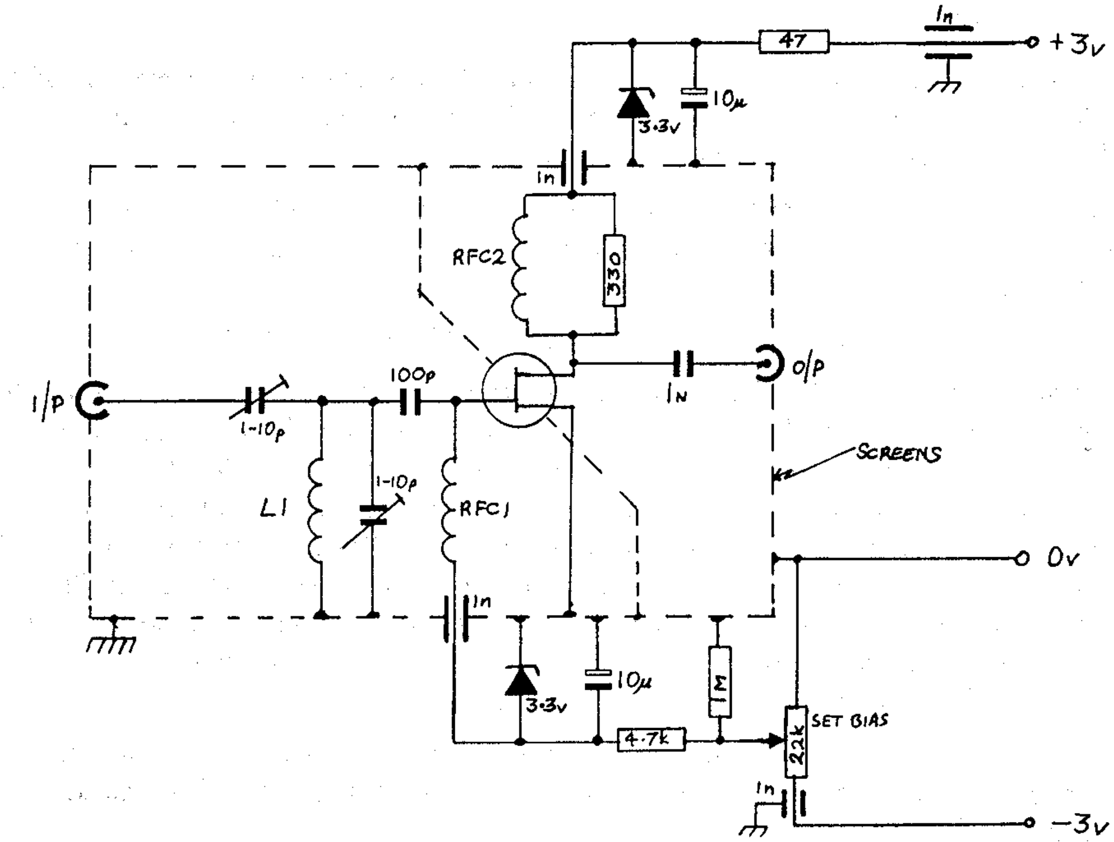


Fig.5: 70cm GaAsFET Preamplifier Circuit

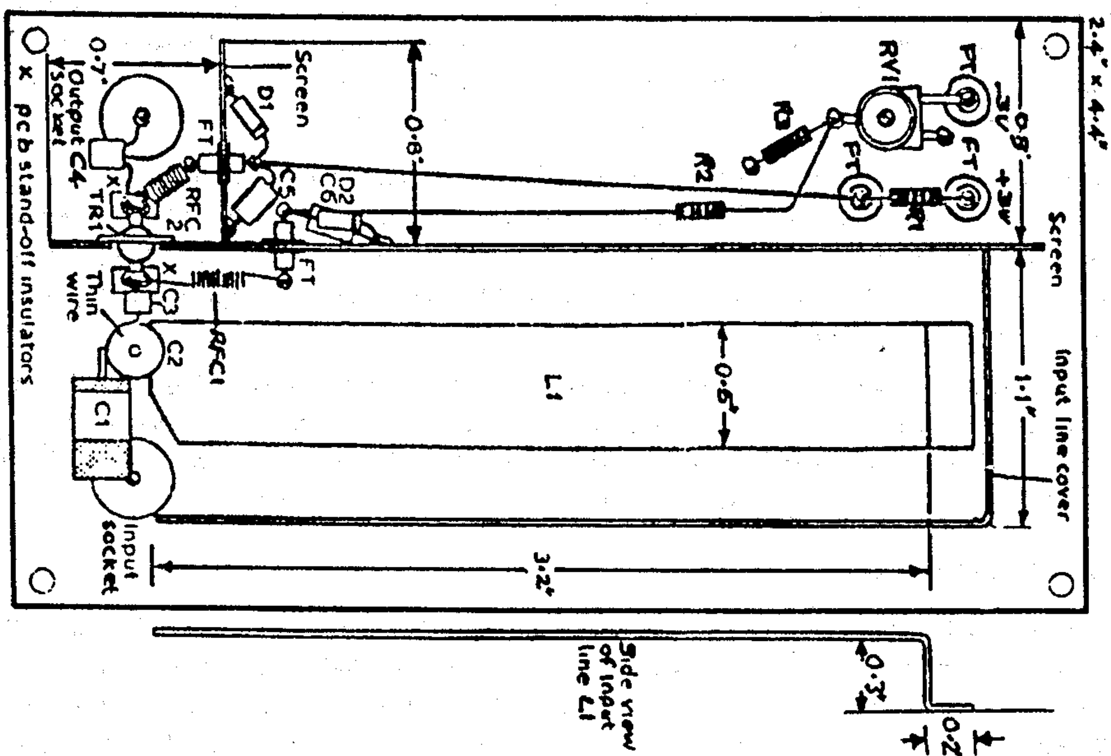


Fig.6: 70cm GaAsFET Preamplifier Layout

The next step is to install the GaAsFET. This requires sensible precautions when handling the device to avoid damage due to transient static voltages. A few simple precautions to be observed are as follows:

1) Do not handle the device in a room where one can draw sparks.

2) Touch earthed objects frequently. Alternatively, a static conducting wristband could be worn suitably earthed.

3) Touch the source lead first when picking up the device.

4) When installing the device in the preamplifier, hold the amplifier chassis at the same time, thus keeping them both at the same potential.

5) When soldering the GaAsFET into the circuit, unplug the soldering iron from the mains and ensure that the iron is earthed to the PCB during soldering.

There are two types of package for the GaAsFET that may be encountered: the threaded stud type and the cross type of package. If using a device in a threaded stud housing, drill a 0.5mm diameter hole in the PCB between the two stand-off pads.

The lead on the device with a 45 degree cut across the end is the gate, the stud is the source and the other lead is the drain. Bolt the device into place and tighten up the nut (gently!) before soldering the leads, in order not to tear them off due to the device rotating. The leads may then be soldered to the stand-off pads previously glued to the ground-plane.

For GaAsFETs housed in the cross type of package, solder the two source leads (again the gate is the lead with the diagonal cut, the drain being diametrically opposite) to the screens on either side of the stand-off pads.

The gap between the two screens can now be closed by soldering some thin metal foil across it. Another metal foil screen can now be soldered over the end and top of the input circuit, leaving access to adjust C1.

The trimmers C1 and C2 need to be low loss types and Johanson or JFD types are recommended. Miniature PTFE dielectric gold-plated trimmers, similar to those supplied by Vero have also been used successfully, as have Sky trimmers (piper Communications) as have Hewlett Packard types. C3 is ideally a chip capacitor, but an ordinary disc ceramic may be suitable. RFC1 is constructed from 15 turns of 26 SWG enamelled copper wire, self supporting with an internal diameter of 0.125 inches. RFC2 is 10 turns of 26 SWG wire wound onto the body of R4.

Alignment

Set the bias potentiometer to half way and connect the supplies. For optimum safety apply first the gate and then the drain supplies, as this avoids the device drawing too high a current should the gate supply be applied later than the drain. (once the unit has bee tested and aligned the use of a double-pole switch to apply and disconnect both supplies simultaneously is adequate). The drain current should be initially set to 10mA and can be monitored by measuring the voltage across R1 (approximately 0.5 volts). If the preamplifier is operated without a 50 ohm load on the input, such as the aerial, spurious oscillations may occur which may result in patterning on the TV screen.

Connect the aerial to the input of the preamplifier and whilst receiving a signal tune C1 for maximum received signal a,d C2 for minimum noise on the screen. Do not be misled into tuning C2 for maximum signal as well, as this will invariably not be achieved at the setting for best noise figure, and a consequent degradation of the system will result.

The Bipolar Preamplifier

The BFR34A preamplifier shown in Fig.7 is built in a similar manner to the GaAsFET device in a smaller die-cast box. Construction is very simple and the layout is shown in Fig.8.

The base and collector of the transistor are soldered to stand-off pads clued to the box and the emitter soldered direct to the PCB. The input and output sockets are located such that only the shortest leads are required on the interconnecting components. A PCB screen is soldered along the whole length of the centre of the board, with the two feed-through capacitors mounted as shown. All the power feed components are mounted onto stand-off pads on the opposite side of the screen from the transistor, with the power being fed into the box via another feed-through capacitor.

As there are no tuning components there is no alignment to be carried out on the unit.

Power Supplies

The bipolar preamplifier can be powered directly from the shack 12 volt supply. The GaAsFET unit can either be powered from batteries, or if it is to be mounted at the aerial by a separate feed cable from a power supply unit such as shown in Fig's.9a and 9b.

Due to the fact that a dual rail supply of + and -3 volts is required, unless the PSU is also mounted at the aerial, powering via the coaxial cable is not possible. However, if the PSU is mounted with the preamplifier then the 'phantom' powering method is shown in Fig.10.

The symmetrical power supply shown in Fig.9 is built around the L165 integrated circuit. In the configuration shown in the circuit diagram, a supply rail of 6 volts will deliver an output of +3v, 0V and -3V, so all you need to do is drop your shack 12 volt supply rail to 6 volts through a regulator and then feed that into this unit.

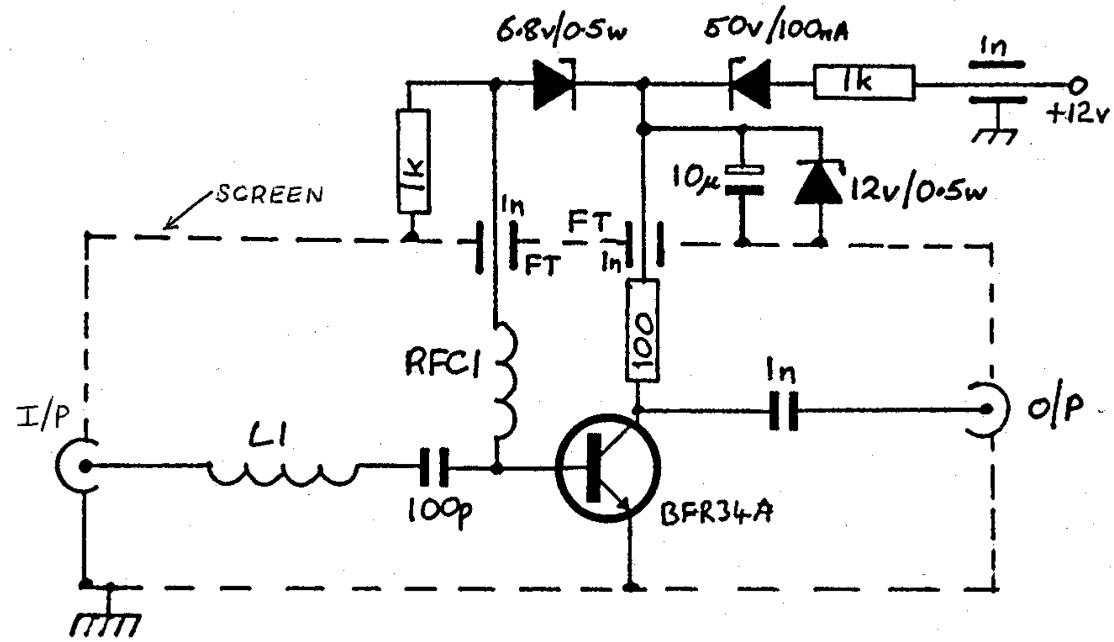


Fig.7: Bipolar Preamplifier Circuit

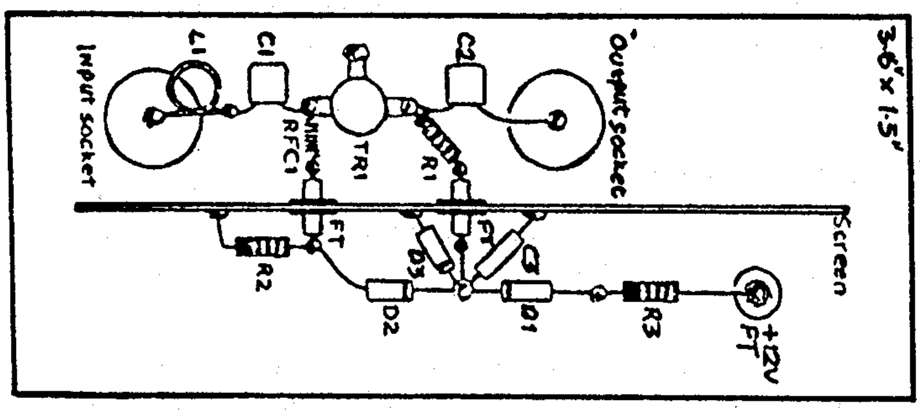


Fig.8: Bipolar Preamplifier Layout

This simple power supply unit can of course have many applications in your shack. The ability to generate a positive and negative supply rail with respect to shack 0V could solve many problems, when all that is readily available is a positive supply and 0V.

A 70cm ATV Transmitter

Introduction

The 70cm crystal controlled transmitter shown in Fig.11 is built onto a double-sided printed circuit board, which features plated through holes and printed micro strip-line inductors to simplify construction and alignment.

The transmitter incorporates a video filter to prevent out of band signals from reaching the aerial, a regulated video clamp, MMIC (Microwave Monolithic Integrated Circuit) amplifier and modulator circuits and a class-AB power integrated circuit for the power amplifier. The RF output from the unit is approximately 5 watts, a level that is suitable to drive most types of 70cm linear amplifiers, which mostly require 5 - 10 Watts drive.

A high quality printed circuit board is available from BATC Members' Services, as is a suitable crystal (output frequency = crystal frequency x 4).

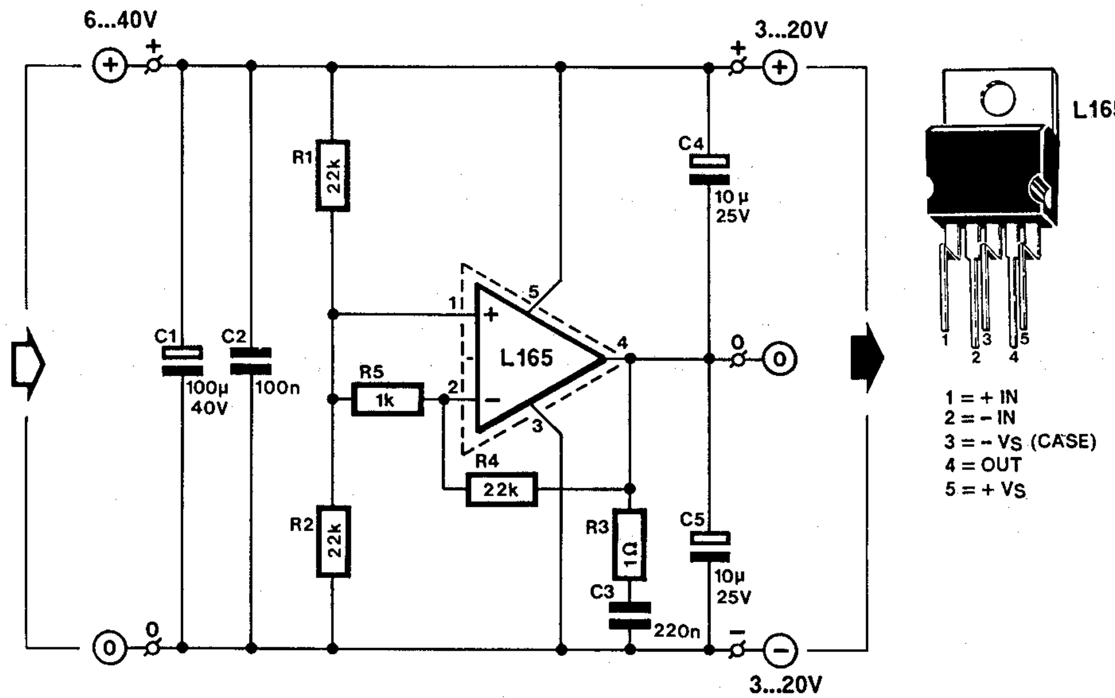


Fig.9: A Symmetrical DC-to-DC Converter

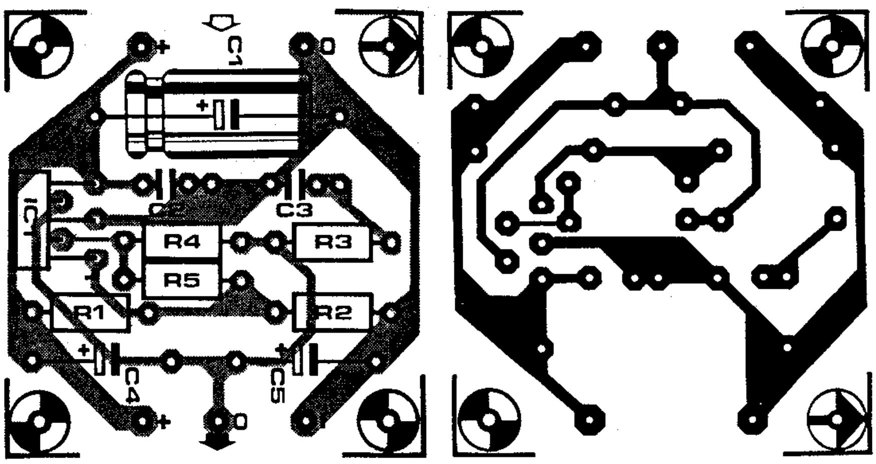


Fig.9b: Layout and overlay for Fig.9

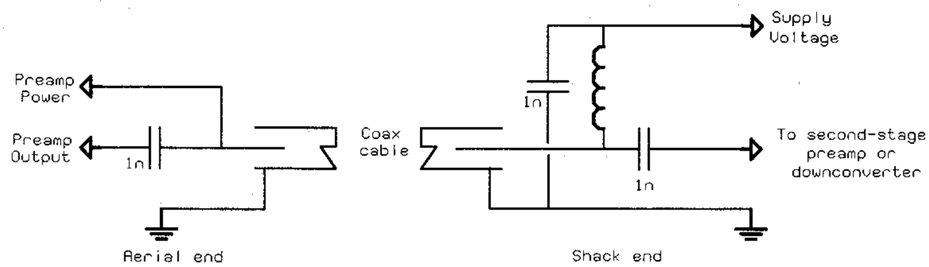


Fig10: 'Phantom' powering remote units via the coaxial feeder

Construction

Before fitting any components on the circuit board file a slight chamfer on the under side of the board at the location of IC3, to allow the leads of IC3 to bend up to the pads without undue strain. Fit the components as indicated on the printed circuit board overlay provided with your circuit board from Members' Services. Keep all component lead lengths to a minimum and ensure that Q2 should is fitted upside down.

Extra care should be taken when mounting the MMICs, IC1 and IC2, as the only indication as to input and output is indicated by the lead with a cross-cut, and once you have trimmed the lead lengths off to fit the soldering pads, the cross-cut has gone! See Fig.12 for package and lead identification.

Two insulated link wires are required, one from the centre of L1 and one by IC3 as shown on the component overlay. DO NOT fit IC3 until the initial setting up procedure described below has been completed.

Initial Setting up Procedure

To be on the safe side, before finally installing IC3 apply 12 VOLTS DC power to the unit and check that the supply regulators are functioning, as excessive volts will destroy IC3. The following voltages should be present on the connecting pads for IC3:

10 volts on pins-2 and 4

5 volts on pin-3

Having ascertained that all is well with the supply voltages for IC3 the device can now be fitted to the circuit board.

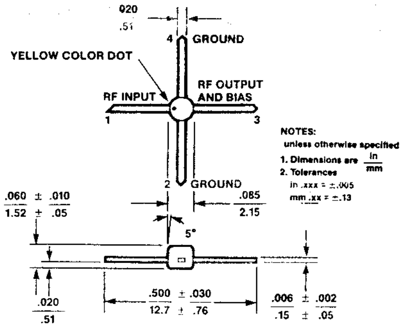


Fig.12: **MMIC Package Details**

Installation

The printed circuit board should be fitted into a screened enclosure. IC3 dissipates up to 15 watts, so the device must be fitted to an adequate heatsink, preferably with heat conducting compound on the mating surfaces. A minimum of 6mm should be allowed between the underside of the board and the bottom of the enclosure. Metal mounting bolts should be used to ensure good grounding between the circuit board and the metal enclosure.

The output coaxial cable should be 50 ohm type, with minimum exposed inner conductor at the terminations. The braid of the cable should be soldered to the underside adjacent to IC3. A BNC or an N-type socket should be used for the output, NOT an SO239.

If the video level control VR2 is to be mounted remote from the circuit board by more than approximately 50mm then it should be connected using thin 75 ohm coaxial cable. The termination switch and R24 should be mounted next to the control.

Power input and switching can be provided to your requirements. It is recommended that the power is fed into the enclosure via 1nF feed-through capacitors. A reverse biased rectifier across the power input is well worth while, as accidents can happen (see Fig.2). The transmitter consumes approximately 2 Amps, so a 2.5 or 3 Amp fuse would be suitable if required.

Setting Up

Set all trimmers and VR1 to half mesh and VR2 to minimum. Connect an RF power meter or SWR bridge to the output and terminate with a 50 ohm load. Apply the 12V DC power and, with a dip meter, counter or monitor receiver closely coupled to L1, C3 or Q1 set the oscillator to the crystal frequency with trimmer C3.

NOTE: to loosely couple the frequency counter or whatever to the circuit, form a small insulated loop at the end of a piece of cable, by joining the inner conductor and screen together, and drop the loop over the indicated component, and connect the other end of the cable to the counter, or whatever.

With the dip meter, counter or a receiver coupled to C10 or near C9 as above, adjust C7 to obtain the fourth harmonic of the crystal frequency, then peak with C9. Turn VR1 fully anti-clockwise and adjust C13 and C14 for an RF output indicated on the power meter or SWR bridge.

Re-peak C7, C9, C13 and C14 for maximum output, between 5 to 7 Watts should be attained. Advance VR1 clockwise to reduce the output to about 4 Watts, advance VR2 clockwise to about half way and apply a 1 volt peak-to-peak composite video signal to the video input. If an oscilloscope and monitor probe are not available the two controls should be adjusted to give the best received picture without signs of crushing of whites or poor sync caused by sync crushing.

If an oscilloscope and RF probe are available, adjust VR1 and VR2 to give maximum amplitude of trace without sync or white crushing. Once set VR1 should require no further adjustment. VR2 is panel mounted to compensate for different input levels.

IC3 and IC4 should be checked to ensure they are not running excessively hot due to inadequate heatsinking.

The plot shown in Fig.13 shows the transmit spectrum of the unit with a colour test card video input. Fig.14 is a plot of the output spectrum of the unit with no applied video signal, showing that the harmonics are >36dB below the carrier.

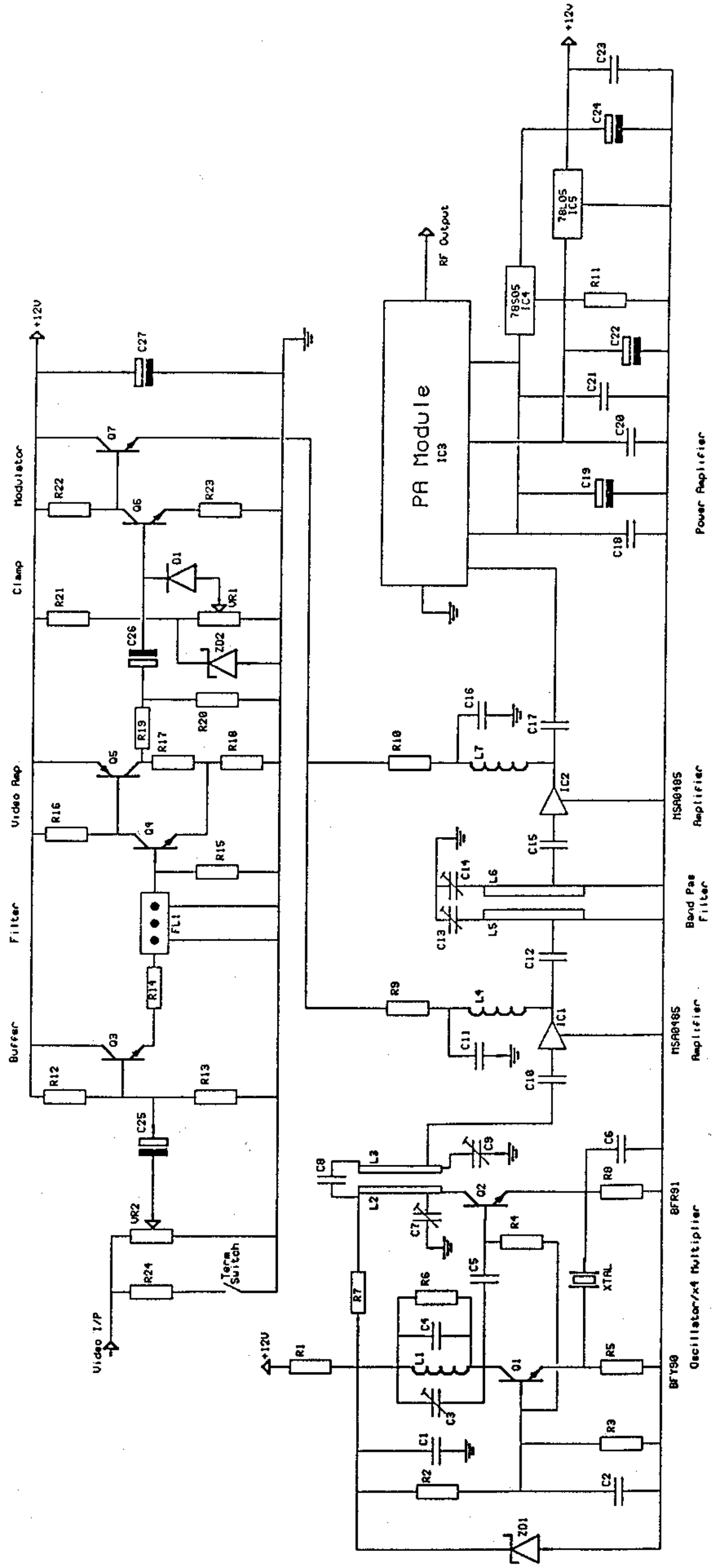


Fig.11: Circuit Diagram of the 70cm ATV Transmitter

Specialist Components

Mainline Electronics most components except IC3. (Appendix D).

Anzac Components for IC3. (Appendix D).

Printed Circuit Board from BATC Members' Services (Appendix F)

Parts List

Resistors:

(all 0.25W metal or carbon Film)

R1	68
R2	1k2
R3	820
R4	1k
R5	820
R6	470
R7	330
R8	390
R9	150
R10	150
R11	270
R12	47k
R13	33k
R14	1k
R15	1k
R16	2k2
R17	1k2
R18	330
R19	68
R20	75
R21	1k
R22	1k
R23	75
R24	82
VR1	1k8 sub min horz preset
VR2	1k LIN

Capacitors:

C1	1n Mono Ceramic 2.54 Pitch
C2	1n Mono Ceramic
C3	2 - 20pF Trimmer Philips 808 Green
C4	27pF Sub Min Plate Ceramic
C5	27pF Sub Min Plate Ceramic
C6	22pF Sub Min Plate Ceramic
C7	2 - 10pf Trimmer Philips 808 Yellow
C8	1nF Mono Ceramic 2.54 Pitch
C9	2 - 10pF Trimmer Philips 808 Yellow
C10	1nF Mono Ceramic 2.54 Pitch
C11	100pF Sub Min Plate Ceramic
C12	1nF Mono Ceramic 2.54 Pitch
C13	2 - 10pF Trimmer Philips 808 Yellow
C14	2 - 10pF Trimmer Philips 808 Yellow
C15	1nF Mono Ceramic 2.54 Pitch
C16	100pF Sub Min Plate Ceramic
C17	1nF Mono Ceramic 2.54 Pitch
C18	1nF Mono Ceramic 2.54 Pitch
C19	1nF Mono Ceramic 2.54 Pitch
C20	10uF 25V Axial
C21	1nF Mono Ceramic 2,54 Pitch
C22	10uF 25V Axial
C23	10uF 25V Axial
C24	1000uF 25V Axial
C25	10uF 25V Axial
C26	1uf 25V Axial
C27	100uF 25V Axial

Active Devices:

Q1	BFY90
Q2	BFR91
Q3	2N3704
Q4	2N3704
Q5	2N3702
Q6	2N3704
Q7	2N3704
ZD1	10V 400mW
ZD2	4V3 400mW
D1	1N4148
IC1	MSA0485
IC2	MSA0485
IC3	M67705M
IC4	78S05

Note: this must be a 2A 'S' Type

IC5	78L05

Miscellaneous:

FL1	237LVS-1109
CRYSTAL	109.125MHz
L1	Printed Inductor
L2	Micro Strip-Line
L3	Micro Strip-Line
L4	22uH Axial
L5	22uH Axial
L6	Micro Strip-Line
L7	Micro Strip-Line
SW1	SPST Min Toggle

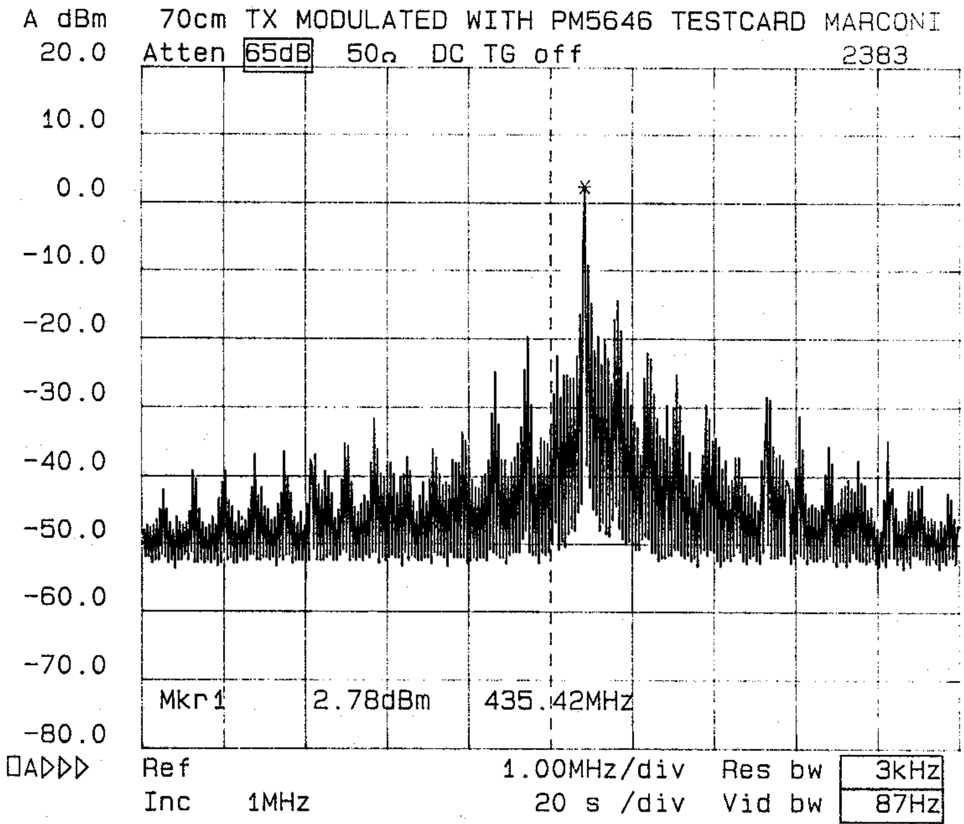


Fig.13: Spectrum of the 70cm Transmitter with a Colour Test Card Video Input

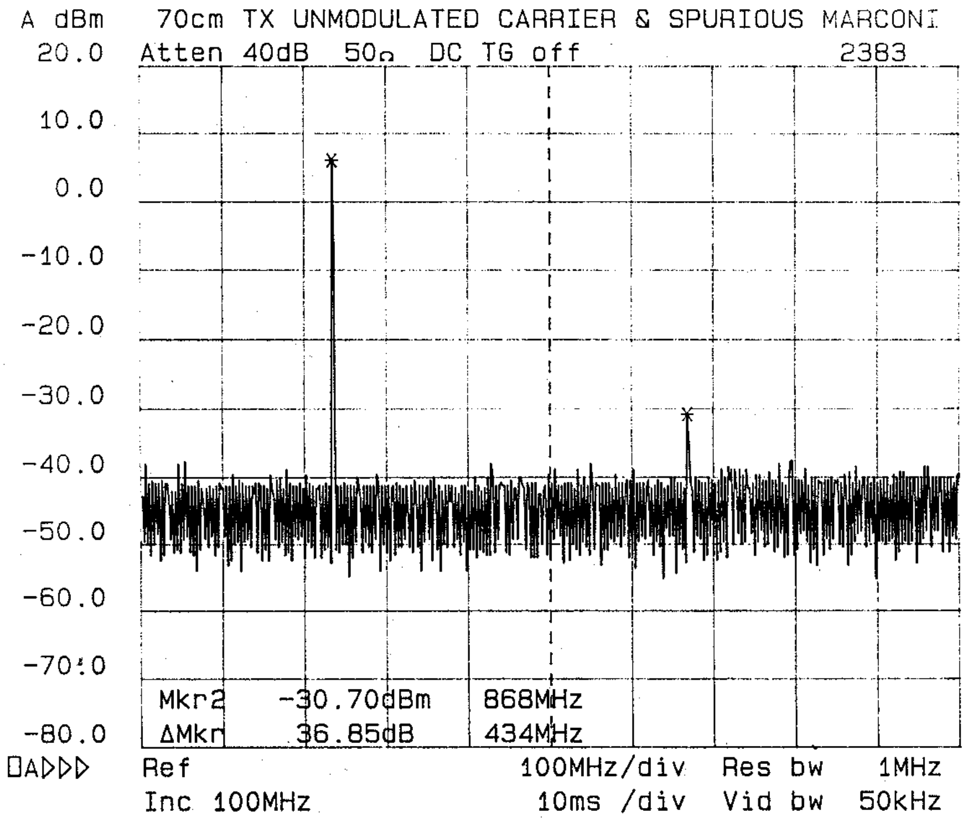


Fig.14: Spectrum of the 70cm Transmitter with no Modulating Video

An RF Probe

A very useful piece of test equipment in the 70cm ATV station is an RF Probe. This simple unit allows you to accurately monitor your transmitted signal, by sampling the actual RF output and demodulating it back to video, so that the quality of the transmitted video can be checked on a video monitor or an oscilloscope.

The video is sampled by inserting a short length of insulated wire into the aerial feeder between the inner conductor and the outer screen. This piece of wire is then connected to the input of the unit. In order to eliminate any stray pick-up, it is suggested that the probe is actually mounted in a tin-plate box and firmly secured to the aerial feeder at the sampling point, and the sampled signal fed into the box via a 1nF feed-through capacitor.

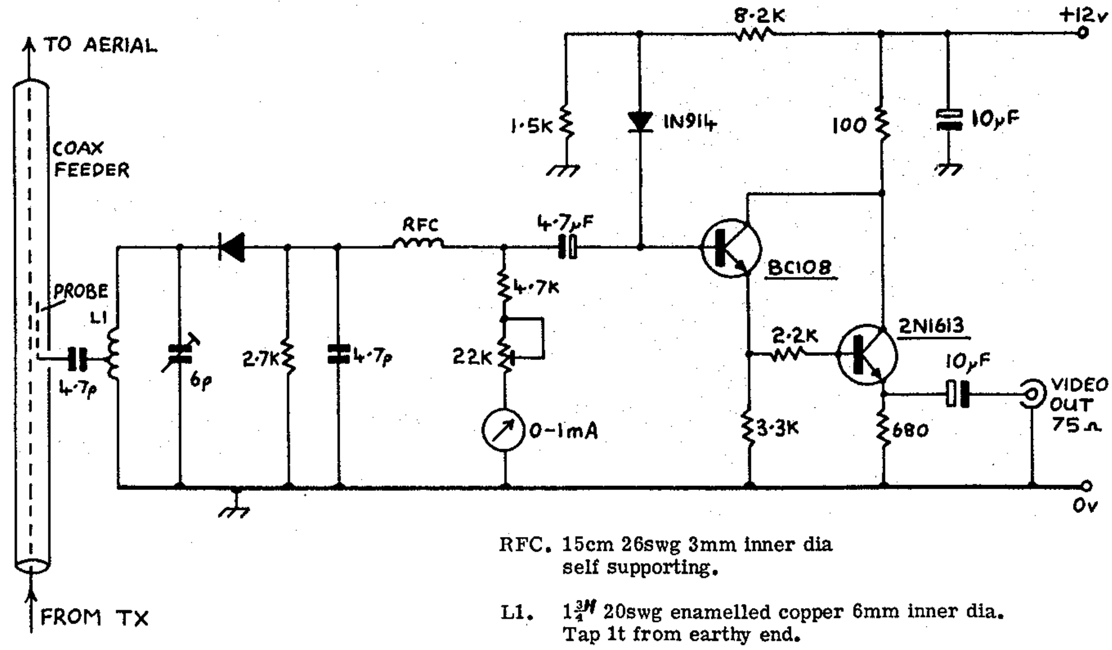


Fig.15: A 70cm RF Probe

The circuit diagram is shown in Fig.15. Construction can be on a piece of Vero board and as stated above the whole unit mounted in a screened enclosure. The pick-up wire should be inserted into the aerial feeder for approximately half an inch, although this length will actually depend upon the power output of the transmitter or linear amplifier in use.

Alignment

Connect the video output from the probe to an oscilloscope terminated in 75 ohms. Transmit a correctly modulated television signal (a receiving station can confirm this) and adjust the input tuned circuit for maximum signal, then adjust the length of the pick-up wire until the video waveform measures 1 volt peak-to-peak.

A 24cm Amateur Television Station

Although traditionally thought of as a band for more advanced work, 24cm (1.3GHz) now has quite a large number of ATV repeaters around the country (Appendix C). Also, it is something of a myth that contacts on this band are wholly line-of-sight and that no DX is possible. It happens quite often that conditions on 70cm and below may be relatively ‘flat’, whereas on the lower microwave bands things are quite active, and very good DX can be found.

The 24cm band does not necessarily have a much reduced range when compared with 70cm transmissions. However, it must be said that given a poor path between two stations, then the lower frequency will undoubtedly out-perform the higher one. The main reason for this is that as frequency increases, obstructions along a path will increase the attenuation of the radio waves. Therefore, for 24cm to be effective over long distances, it is of great benefit if the stations are located on fairly high ground, enabling a wide area to be ‘seen’ by the aerials. This is not to say that all successful contacts are made over line-of-sight paths, far from it, but it does help.

However, even if you are in a rather poor location, you may be able to work through a local repeater, and you may be surprised at just how far your signal can reach - especially during an opening, which tends to be often more intense on this band as mentioned earlier.

This chapter includes two 24cm ATV receivers, two transmitters and a 24cm preamplifier.

A 24cm ATV Receiver

Introduction

The design presented here is for an FM receiver for television signals in the 23cm band. The receiver has been designed to work from a nominal 12 volt supply to allow its use as a portable device, for those amongst us who have to climb the odd mountain to enjoy our hobby.

The receiver is based on an ASTEC TVRO module designed for satellite reception, which happens to cover our 23cm band, and has an acceptable sensitivity to go with it. To improve the sensitivity a two stage preamplifier has been designed and forms part of the circuitry on the PCB. This feature can be bypassed, or the components not fitted as desired.

The module has two RF inputs, which are selected by a pin diode switch, and each input has its own filtered input pin to allow an LNB (Satellite down converter) to be fed power via the coaxial cable. This has allowed an additional feature to be included in the design - the second RF input can be from a standard LNB (if you want to watch SKY) or by using a modified LNB you can use the receiver as a tunable IF for 10GHz (3cm) working.

An alternative use for the second RF input would be to power an RF preamplifier mounted at the masthead via the coax.

Specifications

Tuning range 1100 to 1300 MHz (changeable to 950 to 1750 MHz by simple modification)

- Sensitivity -80 dBm with preamp, -65 dBm TVRO direct
- AGC Range 65 to 15dBm
- Receiver Bandwidth Switchable 36, 24, 18 and 14 MHz)
- Video Output 1 Volt peak-to-peak into 75 ohms
- Audio output 500 mW into 8 ohms
- Audio IF tunable

A printed circuit board is available for this project from BATC Members’ Services and is designed to allow as many of the capabilities of the TVRO module as possible to be accessed for use. For example, there is a prescaler output from the module. This can be used to provide an input for a frequency synthesizer, whose output could replace the manual tuning. This is not part of the design, but allows constructors as much freedom as possible to build a system to their own special requirements.

Circuit Description

The circuit diagram of the receiver is shown in Fig.1. The incoming signals are coupled to L1 by C3, (L1 and its associated RF choke are printed on the circuit board, as is L2) to be amplified by TR1 (GaAsFET type

AFT 10735) with L2 as its source load. L2 presents a 50 ohm load to IC1, which is a MMIC (Monolithic Microwave Integrated Circuit) the output of which feeds into the Astec module.

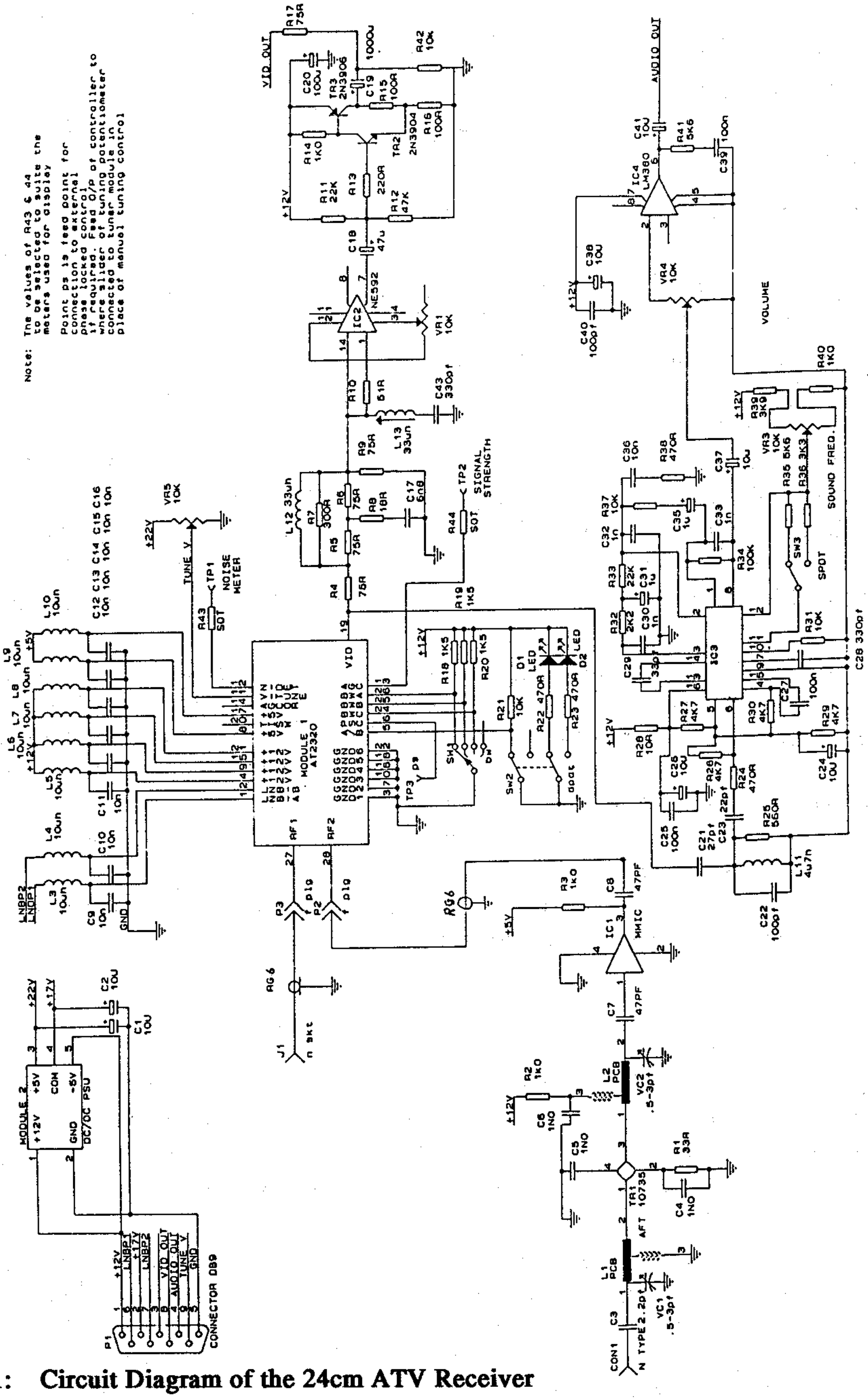


Fig.1: Circuit Diagram of the 24cm ATV Receiver

The module is basically a complete FM superhet receiver in its own right, in that it takes in a signal between 950MHz and 1750MHz and outputs any modulation that was on the signal. This particular module has several interesting and useful features;

a) Two independent RF inputs, selected by pin diodes activated by an external switch, with terminals to allow a supply voltage to be sent up the coaxial cable to feed an LNB

b) switchable bandwidth

c) Noise level output. This can be used to drive a meter to give an indication of signal strength

d) A tunable notch filter which can be used to reduce interfering signals (This facility has not been developed in this design).

The selection of input signals is controlled by switch SW2 which also selects LED indicators to allow an indication on the front panel of the receiver.

The selection of bandwidth is controlled by SW1. The bandwidths available are: 36MHz, 24MHz, 18MHz and 14MHz. The receiver will normally be used with the switch set to the 14MHz position for ATV working.

The video signal from the module is fed to a de-emphasis network, and then to the NE592, IC2, to raise the level to 1 volt peak-to-peak, the gain of IC2 being set by VR1. The signal is then fed to the buffer amplifier formed by TR2 and TR3, which has heavy feedback reducing the gain to two, but with a very low output impedance. The output of the buffer amplifier is fed via C19 to R18 (75 ohms) to present the correct impedance to the coaxial connector at the output of the receiver.

The output of the module also feeds, via C21, IC3 (XR215N) which is a phase locked loop (PLL) detector. By changing the voltage applied to pin-12 of IC3 it is possible to tune the PLL to accept audio carriers of differing frequencies than our 'standard' 6MHz. By changing the resistor values between pins-11 and 12, it is possible to alter the bandwidth of the demodulator to cope with incorrectly set up modulators. By replacing R36 with a 10k potentiometer it would be possible to make the detector improve almost all of your local intercarrier sound transmissions.

The recovered audio is then fed via a volume control to IC4 (LM380) to provide an output of about half a watt of audio to an external speaker.

Power Supplies

As stated in the introduction the receiver has been designed with portable operation in mind. To this end the input supply required is a nominal 12 volts. This voltage supplies most of the electronics but for an LNB a supply of about 17 volts is required to overcome the losses in the connecting coax, and also, to cover most of the tuning range of the RF module, a supply of about 24 volts is required.

The higher voltages are obtained by running a DC-to-DC convertor, which has isolated outputs from the +12V supply, and then adding the outputs of the convertor to the incoming voltage. Thus the -5V output of the module is connected to +12V, making the 0v become 17V and the +5V become 22V. The current capability of the 17V supply is approximately 70mA with the NMA1205S module and approximately 200mA with the NMH1205S module.

A 24cm GaAsFET Preamplifier

The circuit of the GaAsFET preamplifier is shown in Fig.2 and is designed around the MGF1402 device, although many other types of common GaAsFET devices can be used with no changes to the circuit. The design is stable in operation and relatively simple to construct, resulting in a preamplifier with a gain of around 18dB which covers the whole 24cm ATV band, from 1240 to 1320 MHz. The unit can be powered from the main shack 12V supply and can be remotely mounted at the receive aerial and 'phantom-powered' via the feeder cable as shown in Fig.10 in Chapter-5, page-57.

Construction

A printed circuit board layout is shown in Fig.3 and a component overlay in Fig.4. The PCB material should be double-sided and of good quality fibre glass approximately 1.6mm thick. All the components are fitted on the printed side of the board, the reverse side being a continuous ground plane.

Before any components are fitted to the board wire 'stakes' connecting the circuit and the ground plane should be soldered in where indicated by dots on the PCB layout in Fig.3.

Next, the two leadless ceramic chip capacitors should be carefully fitted. They should be flow-soldered onto the copper land using a 25W soldering iron. Fit the remainder of the components as shown with the exception of the GaAsFET.

A tin-plate (or PCB material) enclosure should be constructed to exactly fit the printed circuit board. A die-cast box is not suitable here since effective earthing is difficult. The board should be fitted into the enclosure and soldered ALL ROUND on both the top AND the bottom ground planes. Holes to facilitate adjustment of the tubular trimmers should be drilled into the sides of the enclosure in appropriate positions. BNC or N-type sockets should be fitted for the input and output connections. The sockets should be preferably soldered to the enclosure. A cover should be made to be a press-fit over the enclosure and soldered on when tuning etc. is finished.

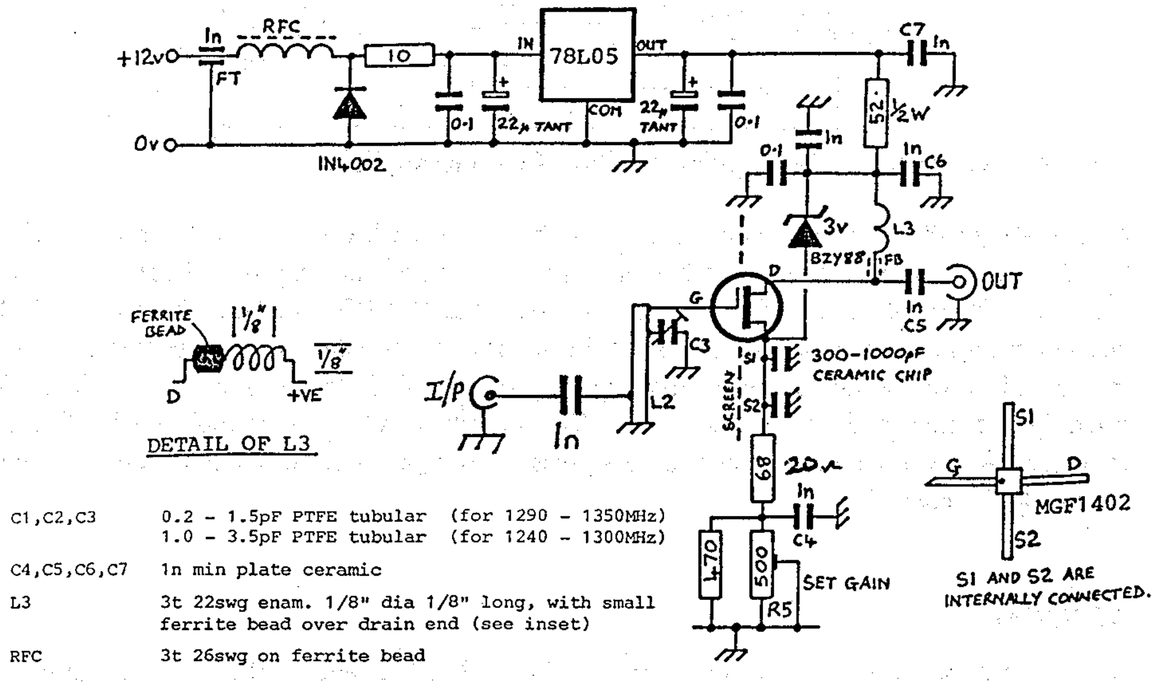


Fig.2: Circuit Diagram of the GaAsFET Preamplifier

Alignment

Before fitting the GaAsFET in place apply 12V to the PCB and confirm that the on-board regulator is supplying the required +5V. The Zener diode biassing circuit may also be checked prior to fitting the GaAsFET by connecting a 0 to 100mA test meter between the S1 and S2 capacitors. Varying the 'SET GAIN' potentiometer R5 should show a point where the current variation stops. This indicates that the circuit is working correctly.

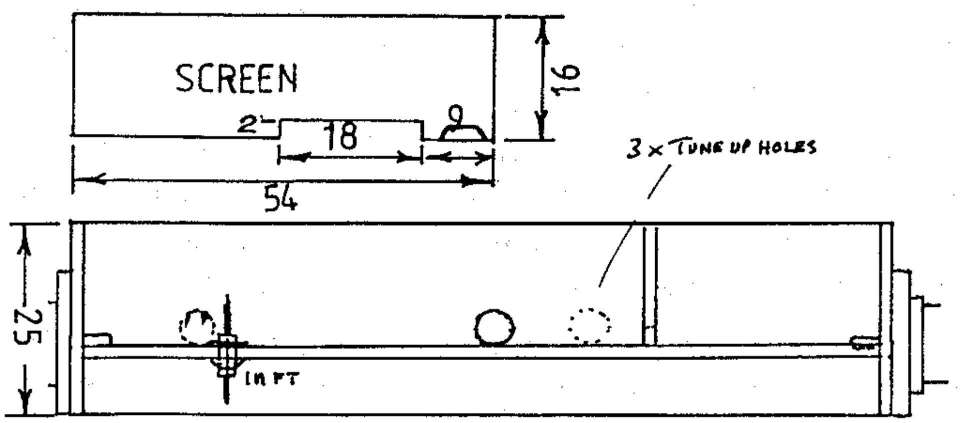


Fig.5: Screen position in the 24cm GaAsFET Preamplifier enclosure

The GaAsFET should now be installed, observing the precautions outlined in Chapter-5 in the 'CONSTRUCTION' section of 'THE GaAsFET PREAMPLIFIER' project.

The PCB, or tin-plate, screen is now fitted as shown in Fig.5. The cutout in the screen is to accommodate the GaAsFET and chip capacitors and should be checked for size before the screen is soldered in place. The lid should now be fitted.

Tune in the ATV receive system to a suitable off-air or local signal source and connect the preamplifier in circuit. Check that the total current drawn by the unit is of the order of 40 to 50mA. Using a non-metallic trimming tool, tune for maximum received signal. Ensure that the signal being received is coming in via the aerial socket and is not a stray pick-up signal. A weak off-air signal is ideal for final tuning.

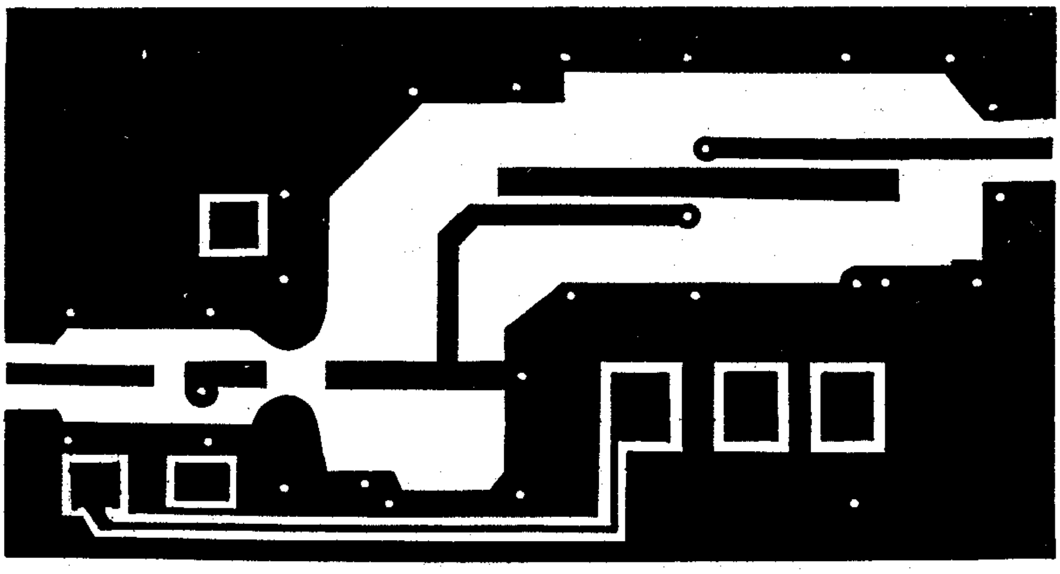


Fig.3: Printed Circuit Boad Layout for the GaAsFET Preamplifier

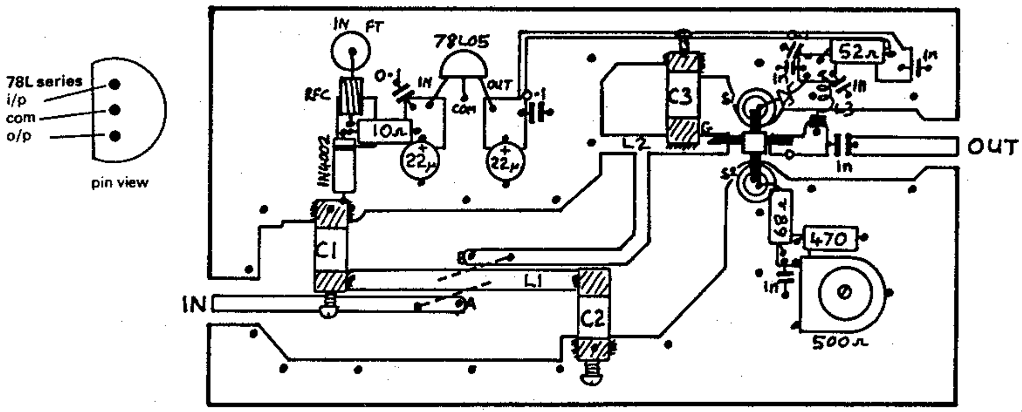


Fig.4: Component Overlay for the GaAsFET Preamplifier

A 24cm Transmitter

Introduction

The unit described here is a single board 24cm FM ATV transmitter, using state of the art devices for a compact, stable and reliable unit. A single 75 ohm terminated input is provided for video, a low level low impedance microphone input and a high impedance auxiliary input for DTMF (Dual Tone Multi Frequency) tones, etc., is also provided.

Tuning is continuous from 1230 to 1330MHz using a multiturn pot. On board supply regulation is provided to allow operation from an unregulated 12 to 15v DC supply. Current consumption is approximately 1 amp.

A high quality printed circuit board and construction details are available from BATC Members' Services.

A simple design for a complementary 24cm Power Amplifier is also included in the following section of this chapter.

Circuit Description

The circuit of the transmitter is divided into four sub units, in Fig.6 is shown the Video input and processing circuitry, in Fig.7 the Audio input and processing circuits, in Fig.8 the Audio subcarrier generator and in Fig.9 the 24cm Oscillator and PA stages. The 1V peak-to-peak video input first passes through the pre-emphasis network and then into IC1. The video gain control VR3 feeds a DC voltage to Q1, and as this voltage increases the source to drain resistance of Q3 decreases, which in turn increases the gain of IC1.

Components C7, Q2, Q3 and Q4 clamp the video and generate bias for the oscillator Q5. Inductor L2 and capacitor C10 form a 6MHz trap, to prevent the audio subcarrier from affecting the clamp. Q5 and associated components forms the oscillator, which runs at output frequency. Tuning is achieved by the variable voltage applied to CD1 from the multiturn tuning potentiometer VR4.

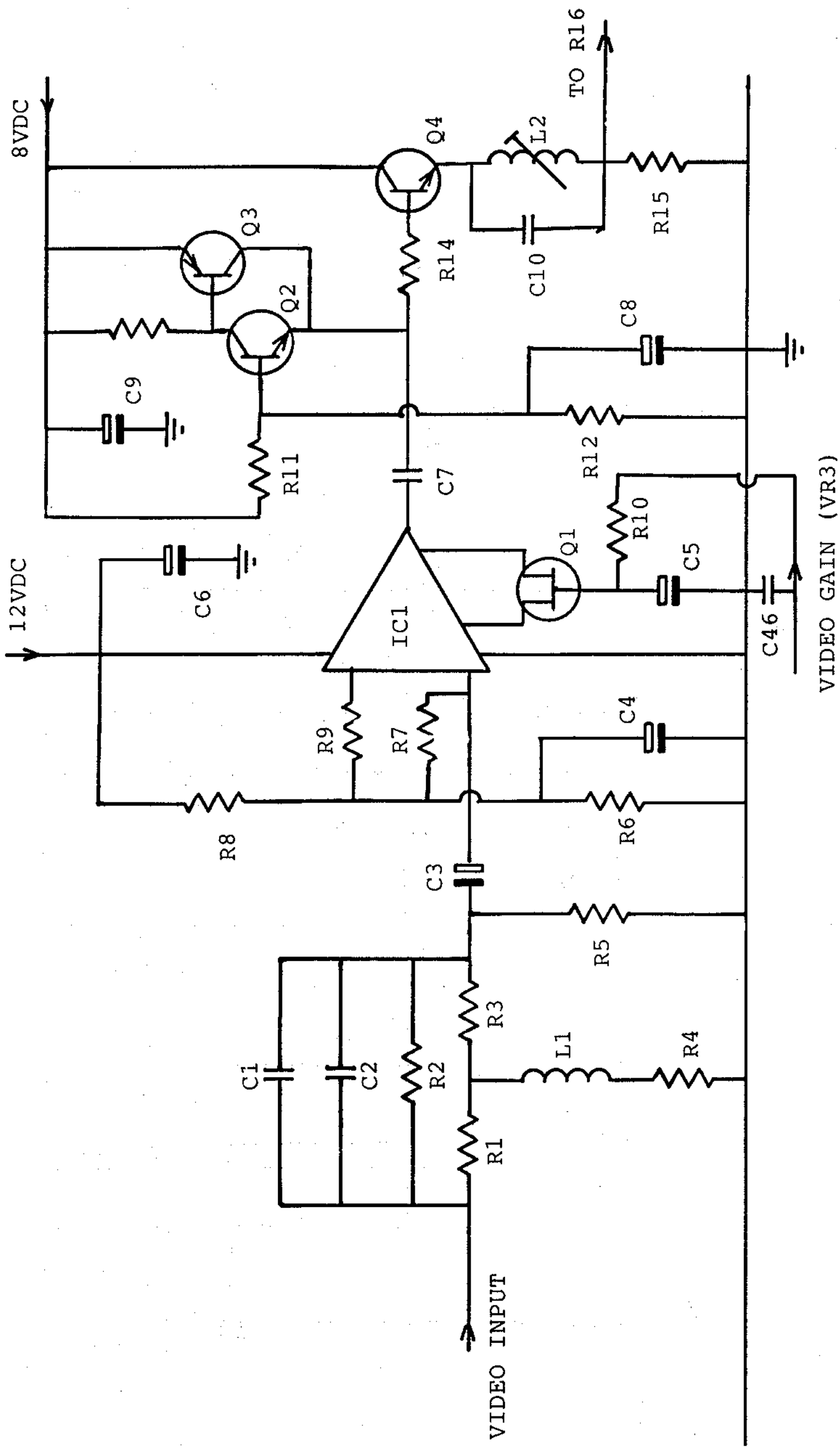


Fig.6: Circuit Diagram of the 24cm Transmitter Video stages

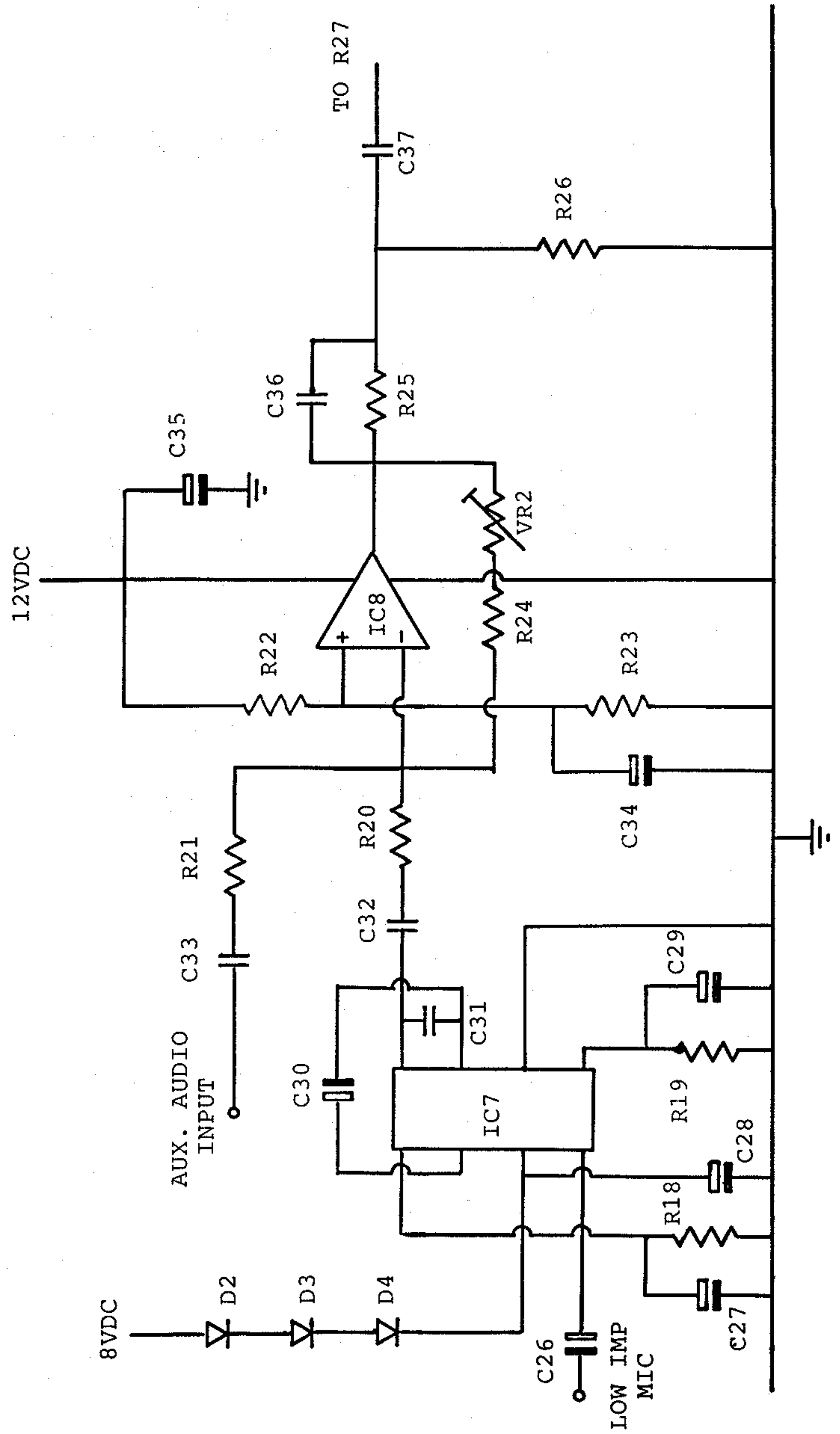


Fig.7: Circuit Diagram of the 24cm Transmitter Audio stages

Bias and the modulating video signal is applied to the base of the oscillator transistor Q5, which frequency modulates the carrier. IC2, L8, L9 and IC3 form a band pass filtered, 50 ohm amplifier, which feeds in the order of 10mW into IC4, the PA module, which amplifies this signal to approximately 1.5 Watts.

The low level low impedance microphone signal is first amplified in the VOGAD chip IC7, with C27 controlling the gain decay. Microphone audio and auxiliary audio are mixed and amplified by IC8, potentiometer VR2 controlling the gain of the IC, and hence the audio deviation. C36, R25 and R26 form a simple audio pre-emphasis network.

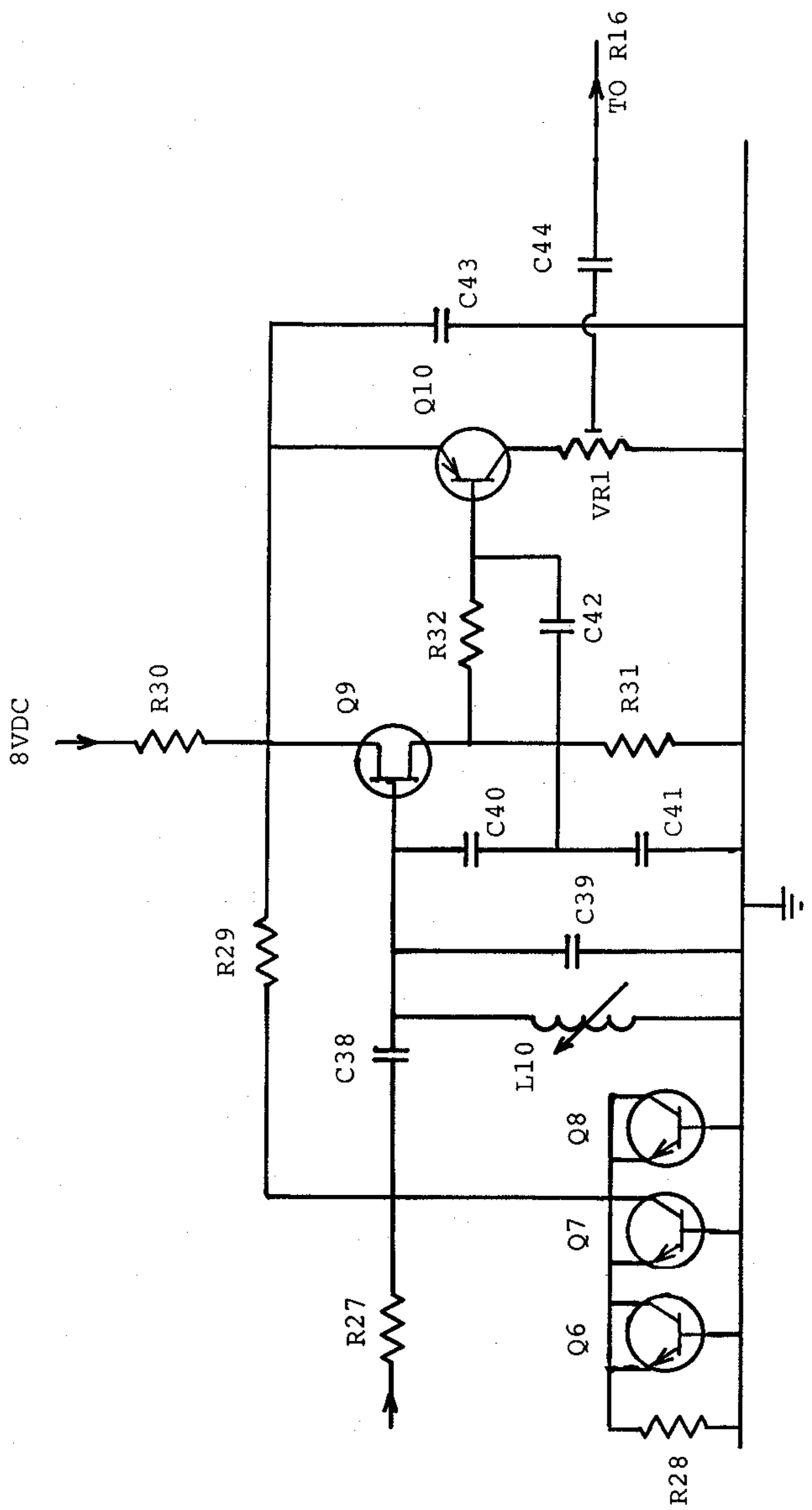


Fig.8: Circuit Diagram of the 24cm Transmitter Audio Subcarrier Generator

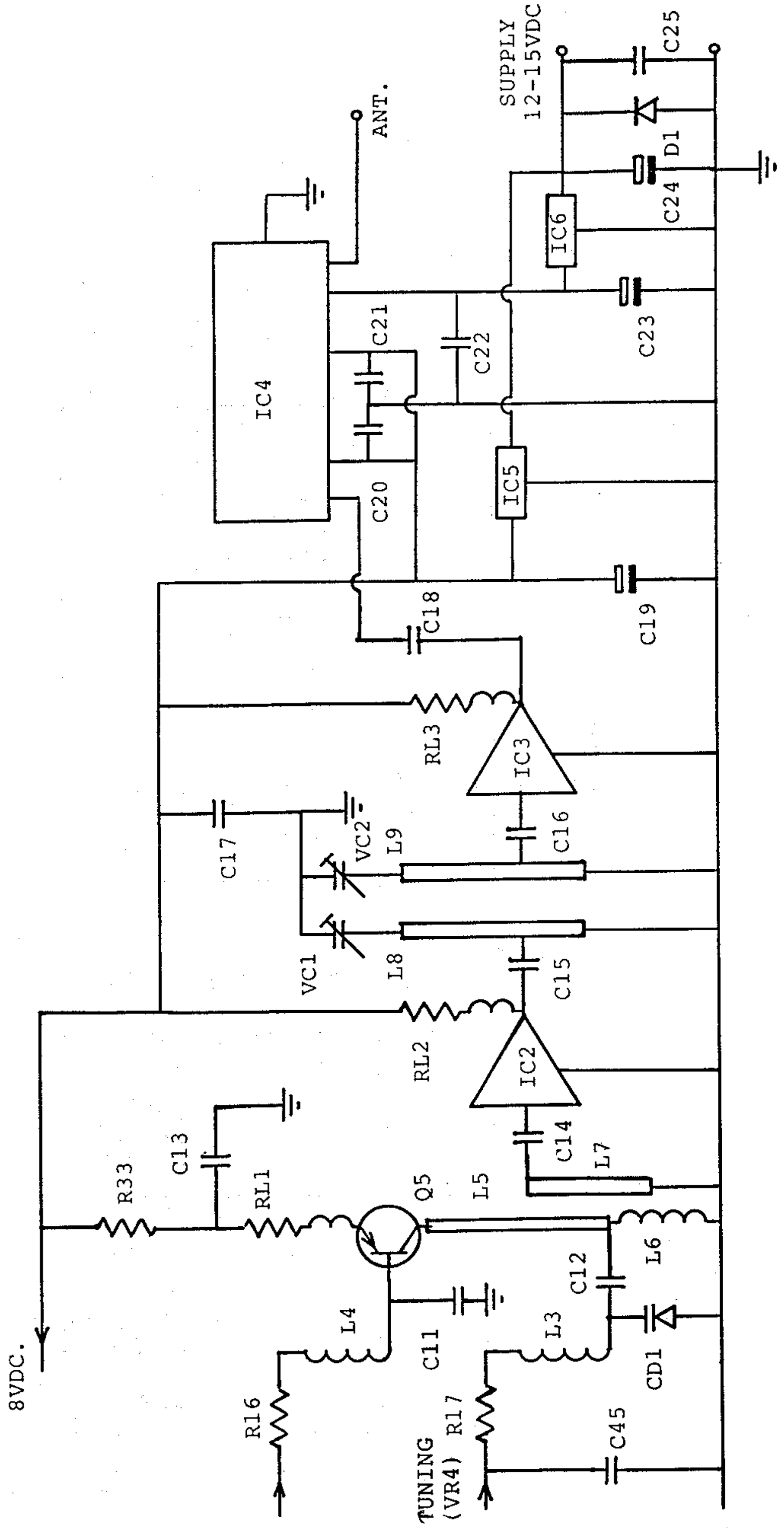


Fig9: Circuit Diagram of the 24cm Transmitter Oscillator and PA stages

Transistor Q9 and its associated components form a 6MHz oscillator, which is frequency modulated by the audio signal applied to the reverse biased transistors Q6 to Q9. Q10 acts as a buffer and VR1 controls the subcarrier level.

One unregulated and three regulated supplies are required. The 8 volt supplies are provided on board by IC5 and IC6. IC7 requires 6 volts, which is derived by reducing the 8 volt supply through D2, D3 and D4.

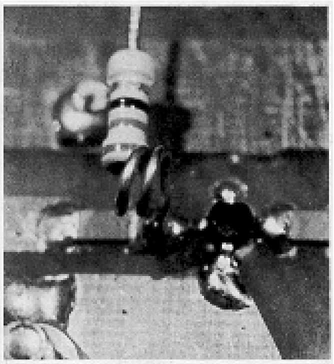
Construction

For ease of construction the double sided printed circuit board features plated through holes. Before fitting components file a slight chamfer on the top side which will allow the pins of the PA device IC4 to be soldered to their respective PCB pads without causing any undue tension, and hence the possibility of their breaking under thermal stress. Do not fit IC4 yet.

Referring to the component overlay supplied with the PCB from members' Services, fit the resistors first and then the capacitors. Care is required in correctly locating the surface mount devices, as these often do not have their values marked on them, so take care not to mix them. Tin the printed circuit board connections first and then, with a fine pair of tweezers or a point such as a meter probe, hold the surface mount device in position and tack one end. Solder the other using the minimum of solder, allow to cool, then solder the first end fully.

Trimmers VC1 and VC2 must be fitted the correct way round. Inspect the connections to the trimmers, one runs down the side, the other emerges from underneath. The side contact should be soldered to ground, the other bent out at 90 degrees and soldered with minimum solder to the micro strip-lines. (The reason for this is that when tuning the unit, if these trimmers are not connected the correct way round, then the adjusting screw will not be at RF ground, and thus any trimming tool will cause a detuning effect, and you will find it extremely difficult to find the correct tuning points).

Next fit the diodes, transistors and FETs, followed by IC1, IC2, IC3, IC7 and IC8. Particular care is required with the fitting of IC2 and IC3 due to their small size and markings. The input lead is identified by a diagonally cut end, however, the input and output leads require to be cut short to enable fitting, and as explained in the 70cm chapter, once the leads of the MMIC devices have been cut to length, the diagonally cut lead indicating the input to the device is lost, so be very careful. Fit the coils and inductors next. RL1, RL2 and RL3 are inductive resistors. For RL2 and RL3 form the one lead of the resistor into a coil of 2 turns, wound on a 1.8 to 2mm former as close to the resistor body as possible (see adjacent photograph). Bend the remaining lead out at 90 degrees and cut to a length of 1.5 to 2mm. RL1 is formed in a similar manner, but only 1 turn is required (see adjacent photograph).



Example of inductor formed on a resistor lead

Finally, fit IC5 and IC6, which require heat sinks, and then IC4, which also requires a fairly substantial heatsink with preferably some heatsink compound used as well. The mountings of IC4 fit to the underside of the board.

The external connections may now be made. Two linked power input connections are provided, one supplies IC6 and the other IC4. If required the link can be cut and the supply to IC6 separately switched, to reduce the output power to a few milliwatts for local netting. Screened cable is advised for the audio and video inputs, but is not required for the video gain and tuning controls. The unit should be enclosed in a screened metal enclosure. Ensure that the underside of the board does not short out to the case. A BNC or N-type connector should be used for the RF output, not an SO239.

Alignment

Check for correct component placement and soldering. Connect a power indicator and suitable load to the output. A frequency counter, sensitive wavemeter or monitor receiver is required for checking the 24cm output frequency and a frequency counter or 6MHz FM receiver is required for the audio subcarrier. Obviously if available, more sophisticated equipment may be used. Apply power, the current drawn should be less than 1 amp. Set all controls and presets to minimum (anticlockwise) and monitor the frequency at the output of IC2. Advance the tuning control and check the required range is covered. Range adjust, if required may be made by moving the position of C12 slightly; a few mm towards Q5 will move the range up the band and vice versa. Tune to about 1275MHz and peak VC1 and VC2 with an insulated tool for maximum RF output. The current consumption should now be about 1 Amp. Check that IC4, IC5, and IC6 are not too hot due to inadequate heatsinking.

Advance the wiper of VR2 and use this point to monitor the audio subcarrier. Adjust L10 with a nonmetallic tool for a subcarrier frequency 5.9996MHz. Connect a low impedance low level microphone and monitor the subcarrier on a medium bandwidth FM receiver, modulation meter, or possibly off air. Adjust VR1 for audio deviation of approximately 5khz. Too high a setting of the audio deviation will cause distortion, as will too high a microphone input level. If required a 1k linear microphone level control may be added at the input.

Apply a high impedance audio signal of 0.5 to 0.75V to the auxiliary input and again check. As with the microphone input, if required a 100K linear input level control may also be fitted for this input.

Apply a 1V peak-to-peak unterminated video signal to the input and monitor off air, unless a suitable modulation meter is available. Adjust VR3 for video deviation of approximately 5MHz. If an oscilloscope is available monitor the junction of R15 and R16 to set this level. Set VR2 to give a subcarrier level of 10 to 15% of the video waveform. Excessive audio subcarrier can cause sound on vision. Finally adjust L2 for minimum vision on sound.

The plot in Fig.10 shows the spectrum of the transmitter's carrier and spurious outputs. The plot in Fig.11 shows the spectrum of the transmitter modulated with a colour test card video waveform and a 1kHz audio signal.

Component Listing

Resistors

0.25W Metal or Carbon Film

R1, R3, R5	75
R2	300
R4	18
R6, R8, R12	10k
R16, R17, R27	
R7, R9, R26	1k5
R10, R11,	33k
R22, R23	
R13, R14, R31	1k
R15	560
VR1	1Sub Min Horizontal Preset
VR2	1k Sub Min Horizontal Preset
VR3	47k Lin
VR4	10, 25 or 50k Multiturn

Active Components:

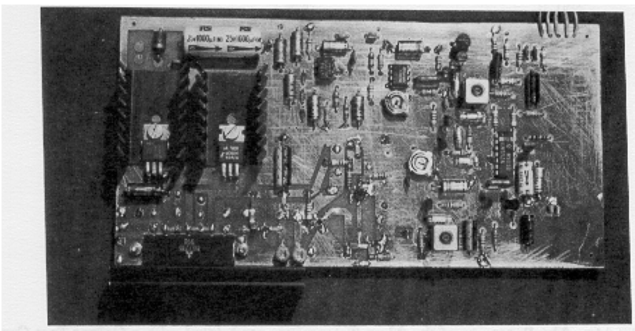
Q1	2N3819
Q2, Q4, Q6	2N3704
Q7, Q8, Q3, Q10	2N3702
Q5	BFT95
Q9	2N3819
IC1	LM592
IC2, IC3	MSA0485
IC4	M67715
IC5, IC6	UA7808
IC7	SL6270C
IC8	TL081
CD1	BB105
D1	1N5401
D2, D3, D4	1N4148

Inductors:

L1	10uH Radial Choke (Toko 8RBS Series)
L2, L10	Toko MKANSK1731HM
L3, L4, L6	0.15uH Surface Mount Choke (Toko 32CS Series)
L5, L7 L8, L9	Printed Micro Strip-Line
RL1	Inductive Resistor 100 ohm + 1 turn (see text)
RL2, RL3	Inductive Resistor 75 ohm + 2 turns (see text)

Capacitors:

C1	1n Ceramic
C2	680pF Ceramic
C3, C4, C6,	10uF 16V Axial
C28, C34, C8, C5, C26, C29	1uF 16V Axial
C7	47nF Polyester
C9, C23, C35	47uF 16V Axial
C10	470pF Polystyrene
C11, C12	10pF Chip Ceramic
C13, C14, C15	1nF Chip Ceramic
C16, C17, C18, C20,	
C21, C22, C19	100uF 16V Axial
C24	1000uF 25V Axial
C25	100nF Ceramic
C27	4.7uF 16V Axial
C30	2.2uF 16V Axial
C31	22nF Ceramic
C32, C33, C38	10nF Ceramic
C43, C45, C46, C36	15nF Polyester
C38, C39	330pF Polystyrene
C40, C4	150pF Polystyrene
C42	3.3pF Ceramic
C44	68pF Ceramic
VC1, VC2	1.5 - 5pF
(Murata Blue TZ03Z050ER)	



A Prototype 23cm Transmitter

Specialist Component Supplies

ICs except IC4, coils, chokes, VC1, 2 and surface mount devices from Bonex (Appendix F). IC4 from Mainline Electronics or Anzac Components (Appendix F).

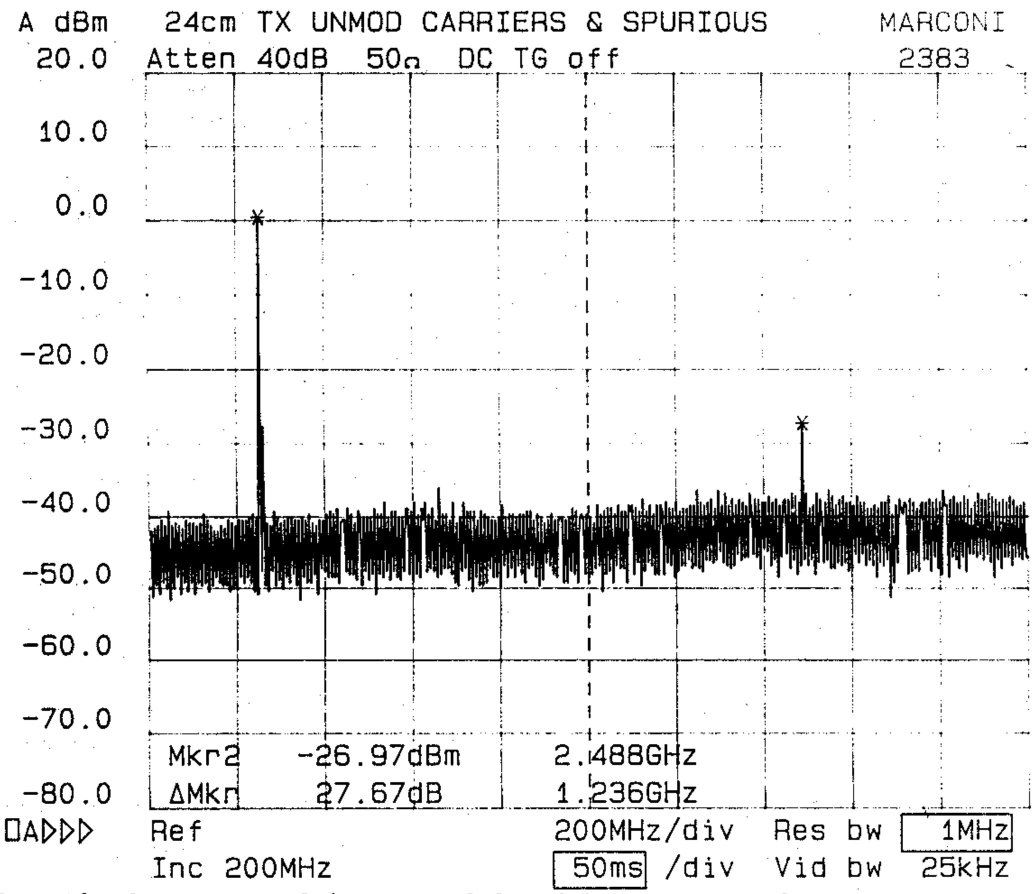


Fig.10: The Spectrum of the unmodulated 24cm Transmitter

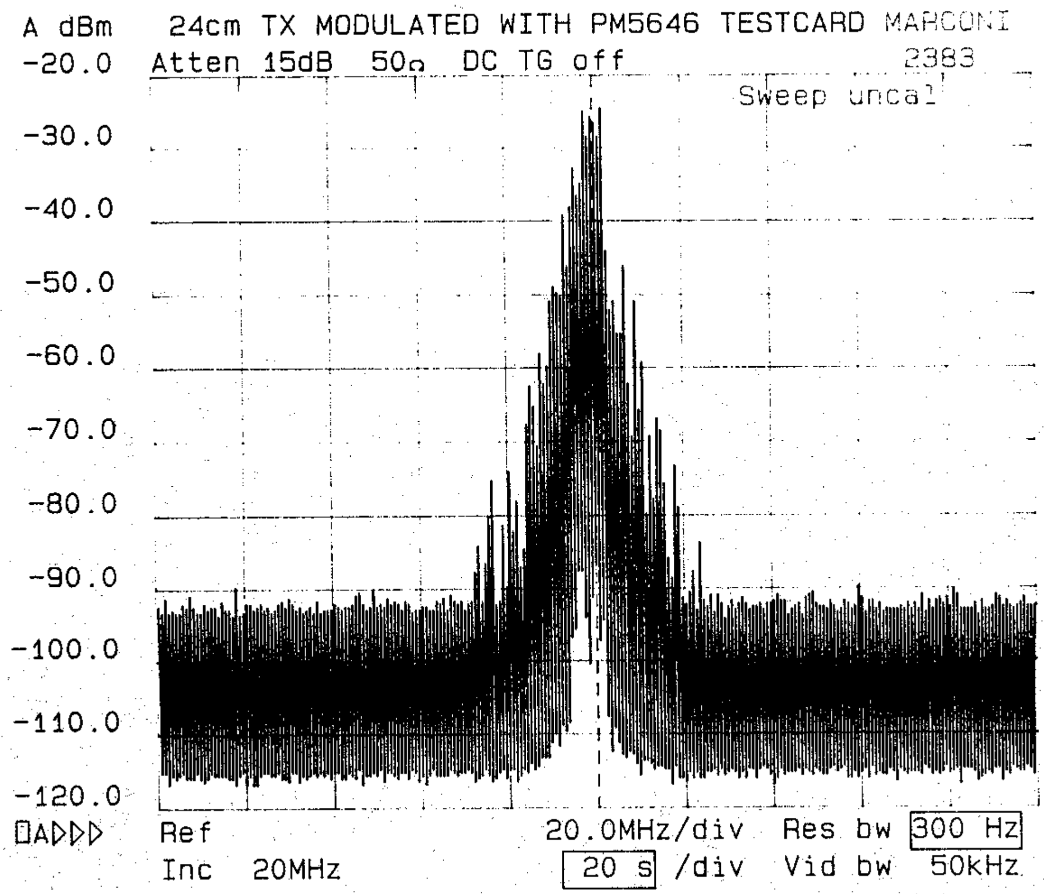


Fig.11: The Spectrum of the 24cm Transmitter modulated with a Colour Test Card

A 24cm Solid State PA

General Description

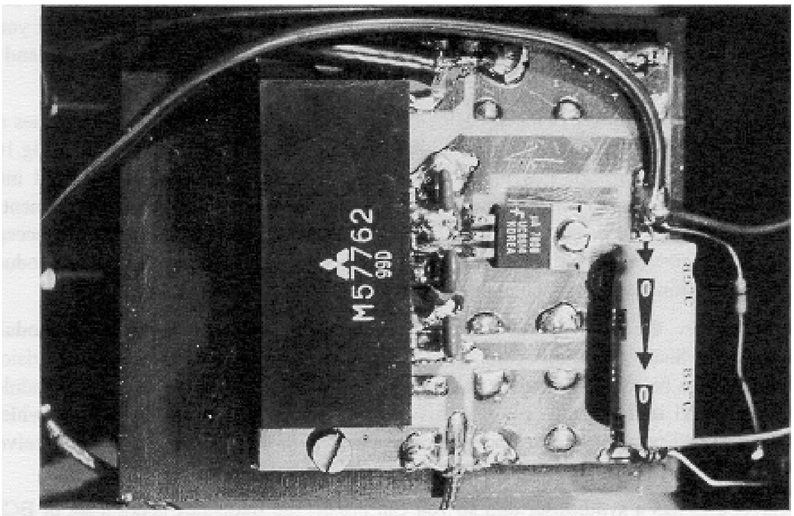
This simple unit is a state of the art 24cm linear power amplifier, requiring an input of 1 to 2 Watts, for a maximum output of 20 Watts over the range 1240 to 1320MHz. The circuit diagram is shown in Fig.12 and the component overlay in Fig.13. Power supply requirements are 12 to 15V DC at 6 Amps maximum. Construction is simple and no setting up is required and an SWR of up to 16:1 can be tolerated by the device. A high quality double sided printed circuit board with plated through holes is available from BATC Members' Services.

Construction

All the components are surface mounted on the top side of the circuit board as shown on the overlay in Fig.13. Mount IC1 last. To fit the 1nF chip capacitors, first tin the tracks, then with a sharp pointed tool or a pair of tweezers tack down one end, solder the other with the minimum of solder, then re-solder the tacked end. The leads for IC2 should not be soldered straight to the board, but bent down at 90 degrees over the top of the pads then soldered, this will alleviate any undue thermal strain causing the pins to fracture. Finally trim back the leads of IC1 and solder in place.

Installation

Installation will depend on individual requirements, however, the following points must be borne in mind. At full power IC1 can dissipate up to 60 Watts of heat. In ATV operation full power is often run for long periods, so a substantial heatsink is required for natural cooling, or as in the authors prototype a 85mm x 75mm x 250mm heatsink forced cooled by a 80mm x 80mm 12V axial fan may provide a more compact unit. Heatsink compound should be used between IC1 and the heatsink after any burrs have been removed. IC2 bolts directly to the circuit board, and the same bolt with spacer should be used to support the PCB. The 50 ohm input and output coaxial cables should have the minimum of exposed inner conductor at each end, and the braids should be divided into two tails and soldered to earth on either side of the inner connections. A BNC type socket for the input and an N-type socket for the RF output is recommended. Supply cables should be as short as practicable and be able to carry in excess of 6 Amps. Power switch and on indicators as required. A 6 Amp diode reverse connected across the power input is cheap insurance against accidents.



A Prototype 23cm Power Amplifier

Commissioning

Simply check the work done and apply DC power. Quiescent current should be of the order of 0.5 Amps. Connect a suitable load and meter to the output and apply 1 to 2 Watts of RF drive to the input. Check that IC1 is not running too hot due to inadequate heatsinking.

Component Listing

C1	1nF	Chip Ceramic	Specialist Suppliers
C2	10uF	Tantalum	PCB BATC Members' Services.
C3	1nF	Chip Ceramic	IC1 Mainline Electronics or Anzac Components
C4	10uF	Tantalum	
C5	1nF	Chip Ceramic	
C6	10uF	Tantalum	
C7	1000uF 25V	Axial	
IC1	M57762	(Mitsubishi)	
IC2	UA7808		
Heatsink	Connectors	Indicators	

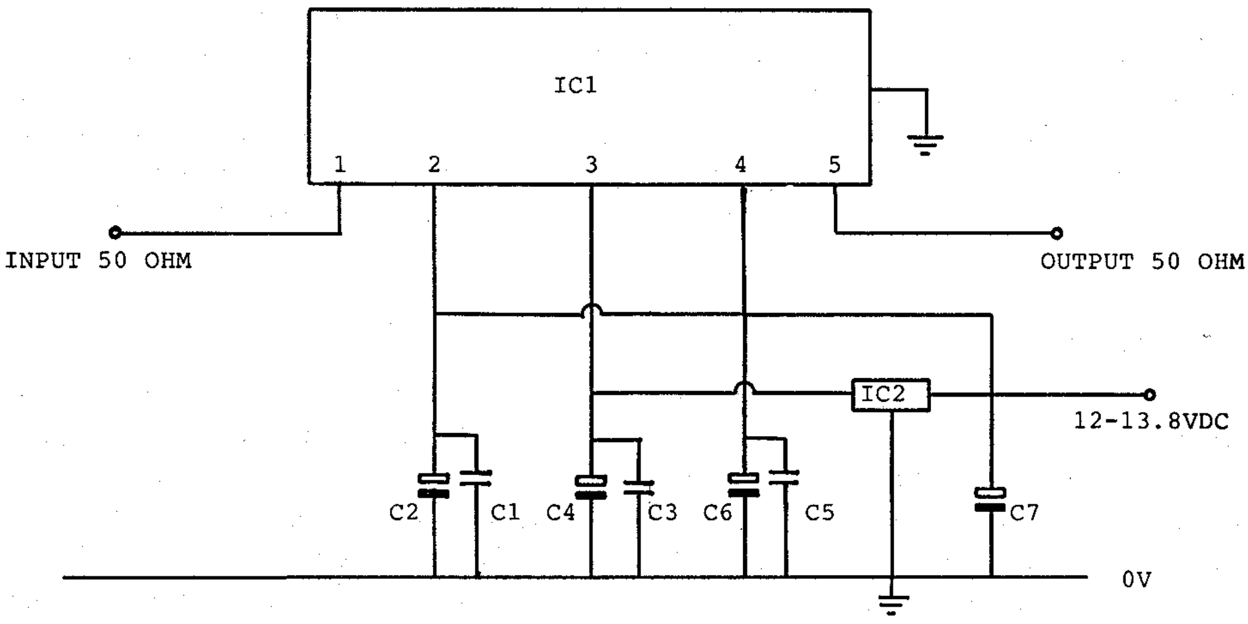


Fig.12: Circuit Diagram of the 24cm Power Amplifier

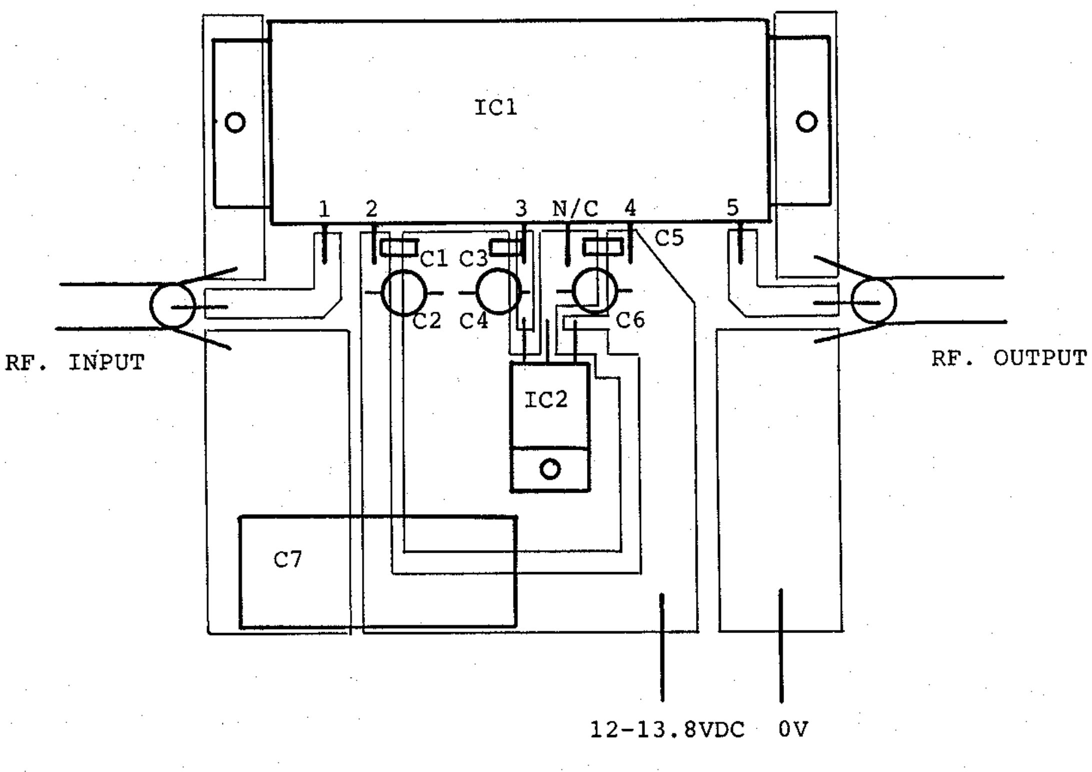


Fig.13: Componet Layout for the 24cm Power Amplifier

THE F3YX 24cm ATV Receiver and Transmitter

Introduction

The 24cm crystal controlled transmitter and accompanying synthesized receiver described below were both designed by Marc Chamley F3YX and they use state-of-the-art surface mount components and design techniques. A set of custom printed circuit boards is available through BATC Members' Services (Appendix F) on which to build them, and both 12 volt DC and mains operation are possible.

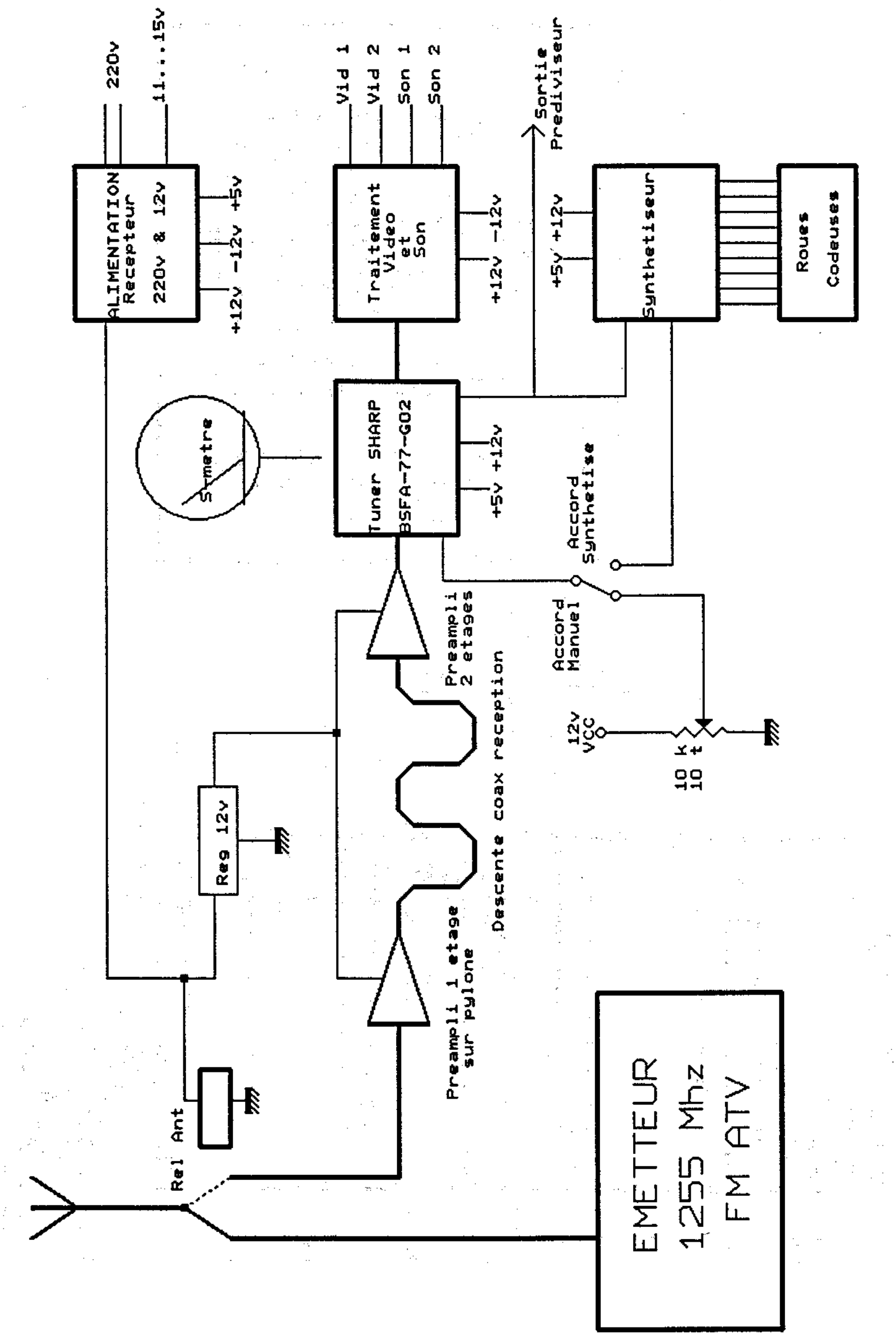


Fig.14: Block Diagram of the F3YX 24cm ATV System

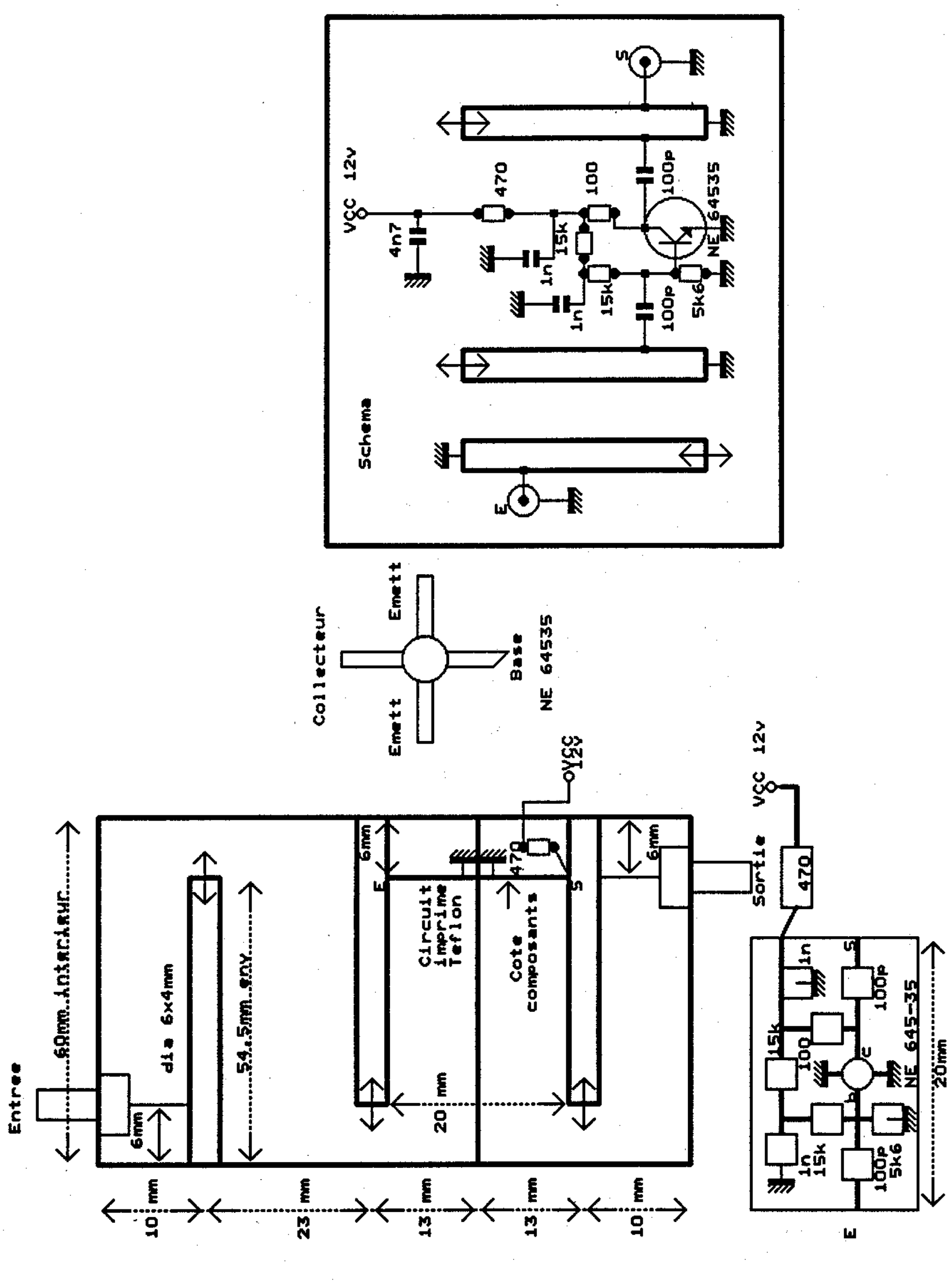


Fig.15: The F3YX 24cm Masthead Preamplifier

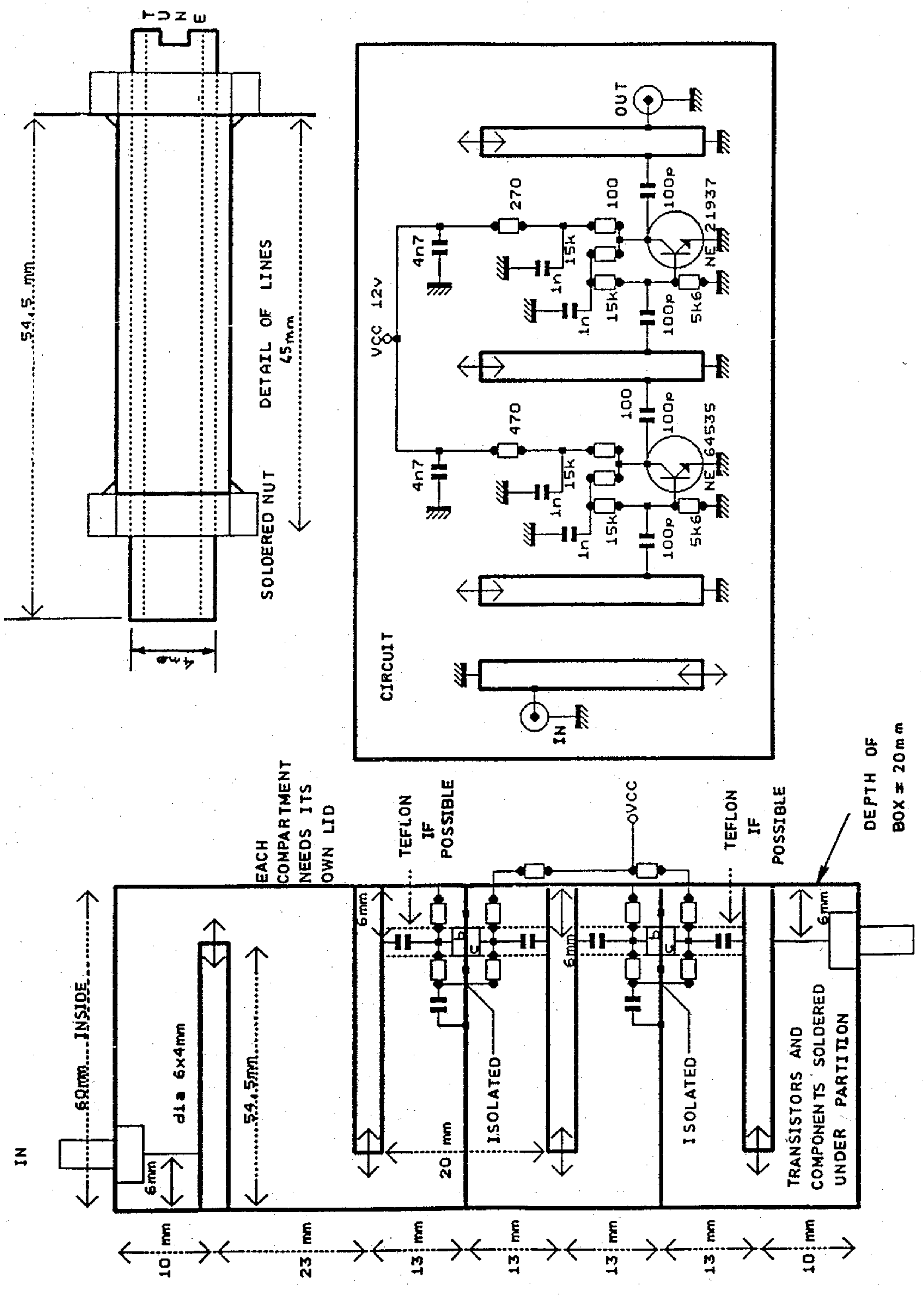


Fig.16: The F3YX 24cm Two-Stage RF Preamplifier

Receiver

An overall block diagram of the 24cm ATV system is shown in Fig.14., and shows that the system comprises an aerial mounted preamplifier, which is fed with DC power via the coaxial cable (see below).

The masthead preamplifier is shown in Fig.15 and uses interdigital tuned lines fabricated from 6mm outside diameter copper or brass tube, with an internal thread tapped at one end for a 4mm screw to be inserted for a depth of 6mm minimum for tuning purposes. It is hoped to be able to get these inductors manufactured and include them with the printed circuit boards (see Appendix F).

The unit should be constructed according to the dimensions shown in Fig.15 and housed in a weatherproof metal enclosure, with appropriate connections for input and output to suit your requirements. The 12 volts DC power for the preamplifier is few via the coaxial cable, and a method for ‘phantom’ powering the unit is shown in Fig.10, chapter-5, page-57.

The main receiver unit uses a two stage RF amplifier with some more of the high-Q lines as are used in the aerial preamplifier. The details of this two-stage RF unit are shown in Fig.16. The printed circuit board for this unit requires several PCB screens to be soldered into position as shown in Fig.16. This divides the RF amplifier section into three compartments, with the two transistors located under the screens. The side screens require drilling to accept the tuned lines, and care must be taken fitting the tiny chip capacitors. The end product requires a good fitting lid over each compartment.

Figure 17 shows the main part of the receiver, which uses a commercial module manufactured by Sharp (Appendix F). This unit comprises of a local oscillator, IF and vision demodulators. The oscillator frequency is controlled by the voltage on pin-11 of the module, and with switch S1 in the manual position this can be set with the potentiometer RV1, which should be a multi-turn type. This potentiometer will then enable you tune the receiver manually.

The receiver also has a synthesiser unit so you can pre set the frequency using a set of BCD (Binary Coded Data) thumb-wheel switches. This works by looking at pin-14 of the Sharp module, which has an output from the internal local oscillator signal divided by 1024 or 2048, depending on which Sharp module you use. This is then compared with a similar frequency synthesised in IC1. The difference in frequency between the local oscillator and the synthesiser produces a DC voltage which is fed to the Sharp module pin-11 when S1 is in the auto position. In this way the frequency of the local oscillator can be controlled by the BCD switches.

Unfortunately the numbers on the switches do not correspond to the received frequency, so the table below will be needed to translate BCD switch legends into actual frequencies:

1245 MHz = 5 0 3
1250 MHz = 4 7 6
1255 MHz = 4 7 1
1260 MHz = 4 6 4
1265 MHz = 4 5 7
1270 MHz = 4 5 2
1275 MHz = 4 4 5
1280 MHz = 4 4 0
1285 MHz = 4 2 1

The synthesiser requires a 4Mhz crystal for oscillators that are divide by 2048 and an 8Mhz crystal for oscillators that are divide by 1024.

The Sharp module also has an AGC output on pin-6, which can be used to drive a 50uA meter for signal strength purposes, the meter is not calibrated but RV2 is used to set zero on the meter. The Sharp module also has switchable bandwidth feature which is facilitated by switch S2. The output of the module is a baseband video signal that is routed to Fig.18.

Fig.18 shows the video and audio processing circuitry. The first thing in the video path is a de-emphasis circuit, to compensate for the pre-emphasis in the transmitter, CCIR and D2MAC values have been given for the components, for UK amateur use CCIR are the ones to use.

The video then passes through a video filter to switch S3. Here we can invert the video polarity should modulation other than positive have been used by the transmitting station. The video is then amplified and buffered by a two-stage transistor amplifier and the end result is a 1 volt peak-to-peak composite video signal at the video output socket VID-1.

The audio is taken off before the video de-emphasis network and routed to two TDA 1047 demodulators, one via a 5.5MHz and the other via a 6.6Mhz ceramic filter to cover different frequency sound subcarriers. The standard used in the UK is 6MHz, so it would be wise to fit a 6MHz filter in one of the positions.

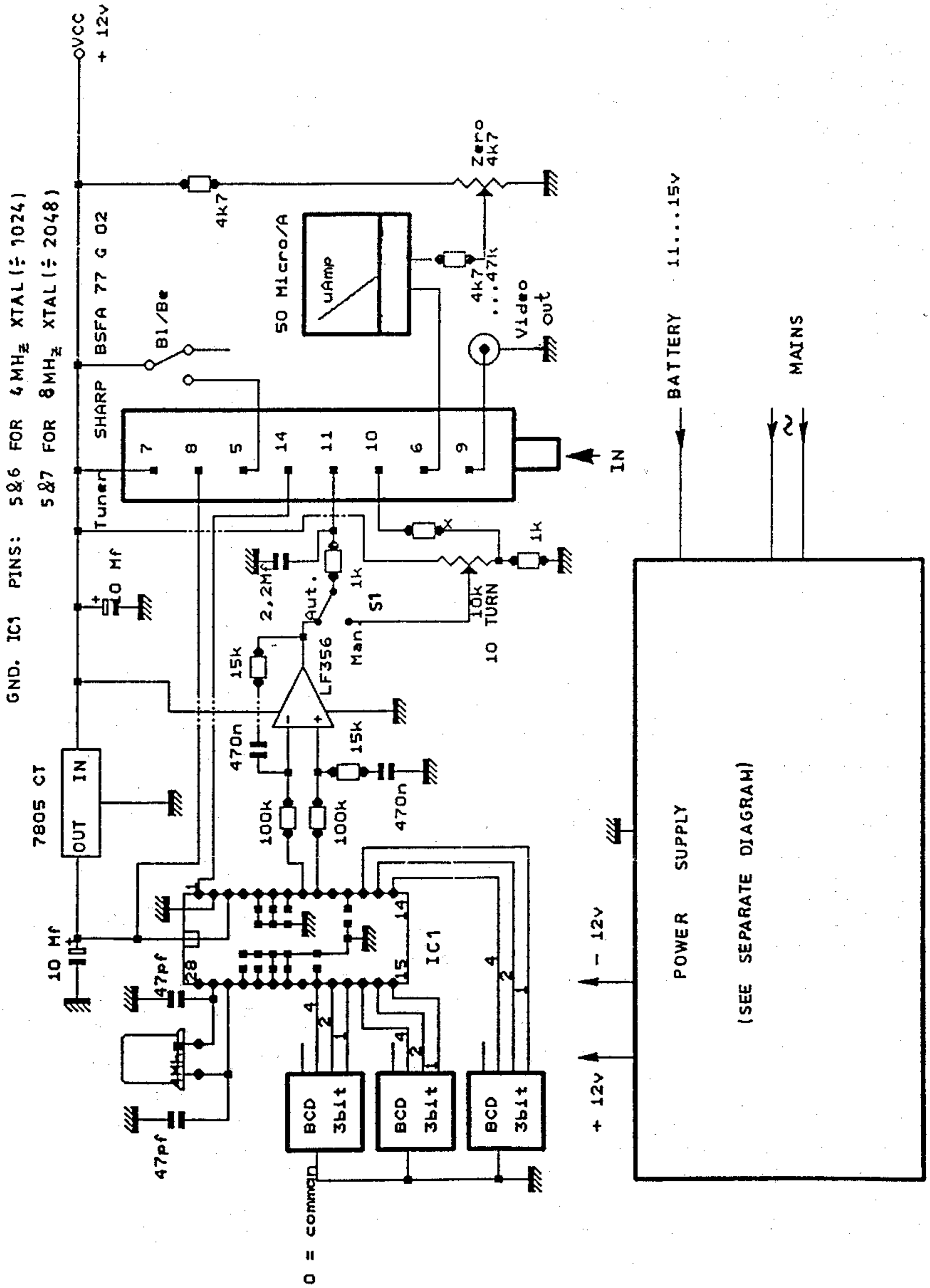


Fig.17: The F3YX 24cm Main Receiver and Synthesiser

Both demodulators feed separate audio outputs, the first being a straight-forward audio output at BF-1. The second demodulator output is modulated back onto the video by T2 and the combined signal output at VID-2, should you have a monitor with an internal sound demodulator. If you do not require this facility, then those components can be omitted.

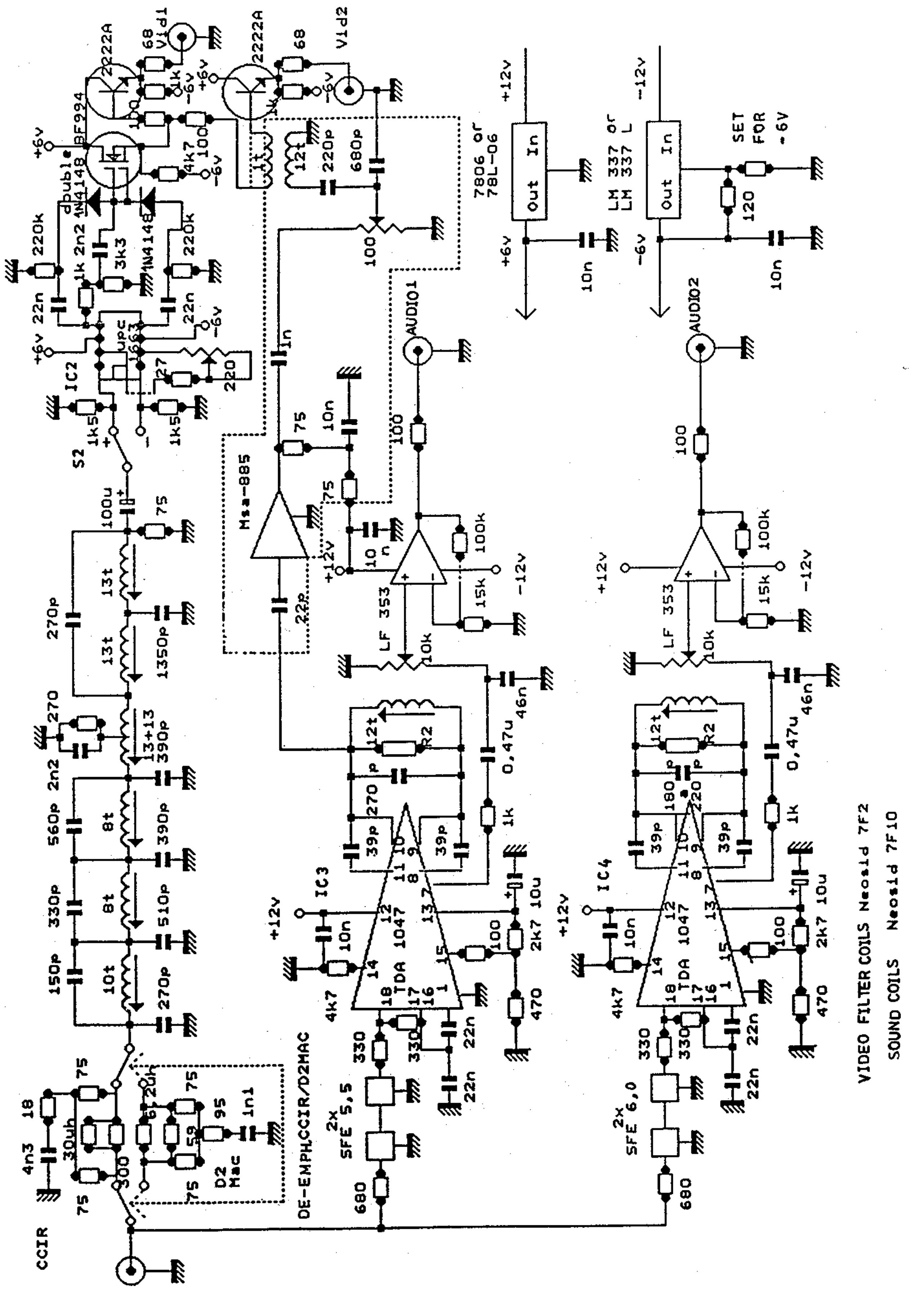


Fig.18: The F3YX 24cm Video and Audio Processing Stages

Fig.19 shows the receiver power supply, which is dual input, i.e: 240 volts AC or 12 volts DC. It features an astable invertor and voltage doubler driving a conventional IC regulator.

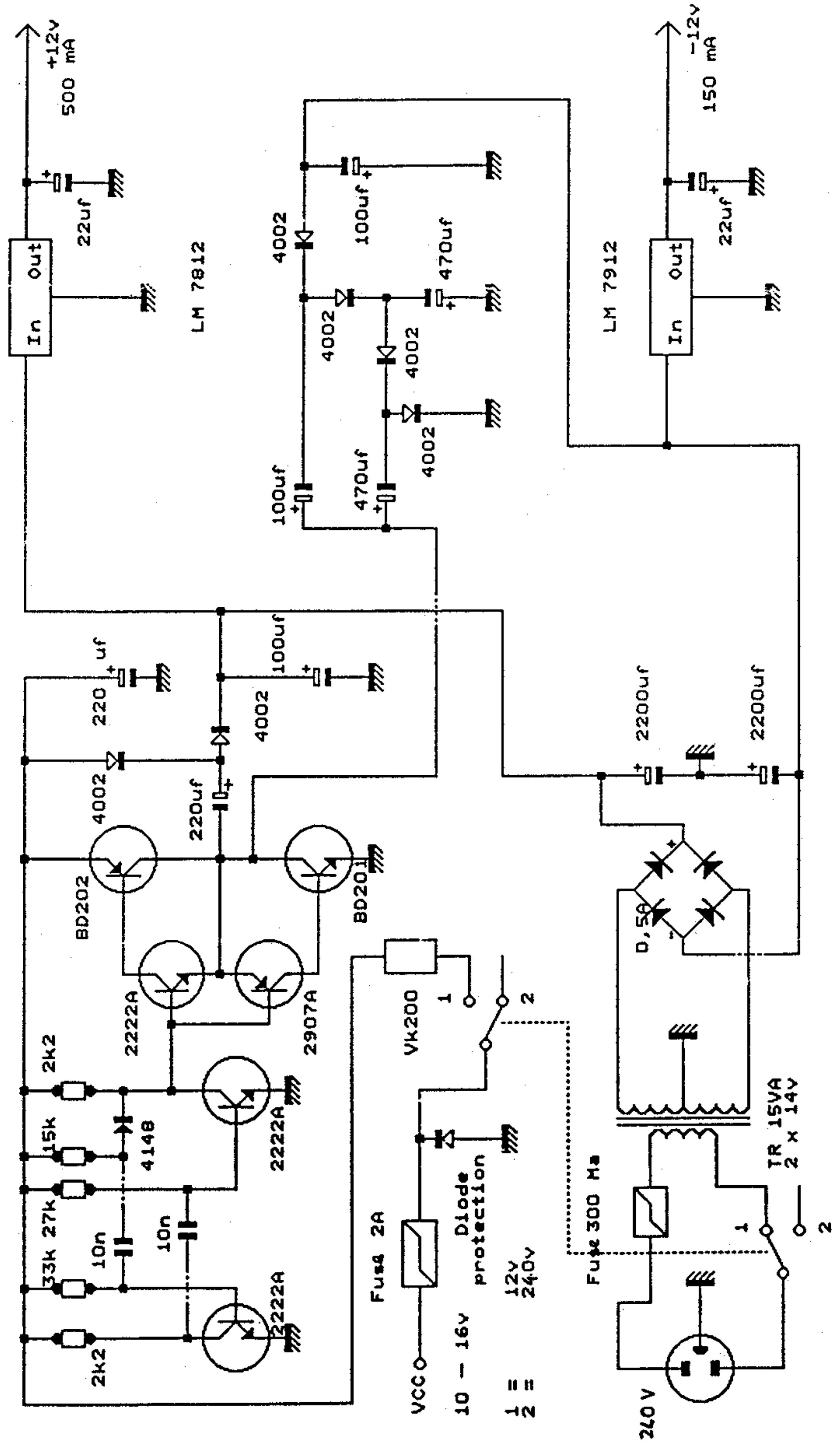


Fig.19: The F3YX 24cm Receiver Power Supply Circuit

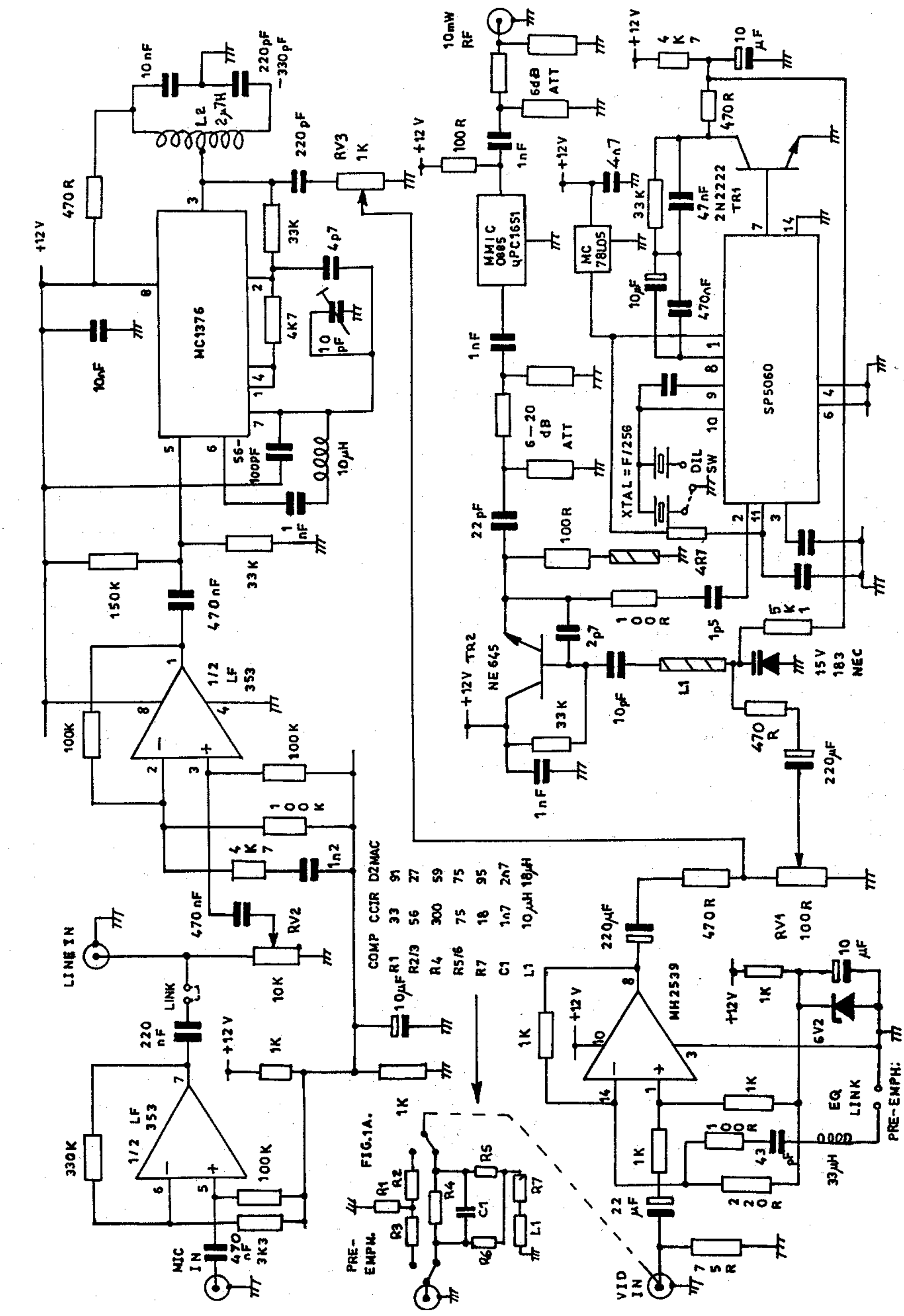
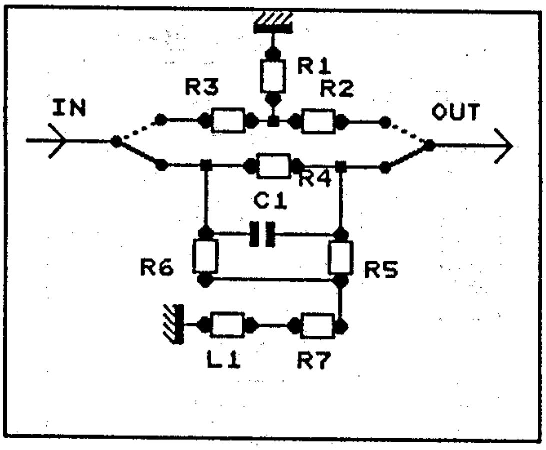


Fig.20: The F3YX 24cm Transmitter

Transmitter

Fig.20 shows the heart of the transmitter, an NE 645 oscillator using printed circuit board strip lines for an oscillator which runs directly at 24cm with no frequency multiplication, as this can often lead to picture degradation in an FM TV system. The frequency is set initially by L1 and the varicap diode.



COMPOS.	CCIR	D2MAC
R1	33	91
R2/R3	56	27
R4	300	59
R5/R6	75	75
R7	18	95
C1	1n7	2n7
L1	10uh	18uh

Fig.21: The Pre-emphasis network and the Component value table

The output of this oscillator is then loosely coupled into the SP 5060 integrated circuit via a 100 ohm resistor and a 1.5pF capacitor. The SP 5060 divides the signal by 256 and compares it with an external crystal, and then derives an error voltage, which is proportional to the difference in frequency between the oscillator divided by 256 and the crystal. The error voltage is then buffered by Tr1 (2n222) and used modulate the varicap diode, and pull the oscillator into frequency lock.

To maintain stability of this oscillator, as much isolation as possible should be put between it and the power amplifier stage. To this end, the signal is routed first via a MMIC (Monolithic Microwave Integrated Circuit) and secondly via 6dB pad. FM television has the advantage over AM that class-C, non-linear, power amplifiers can be used, but these do tend to impose varying loads on the oscillator, that can detract from its frequency stability, hence the isolation.

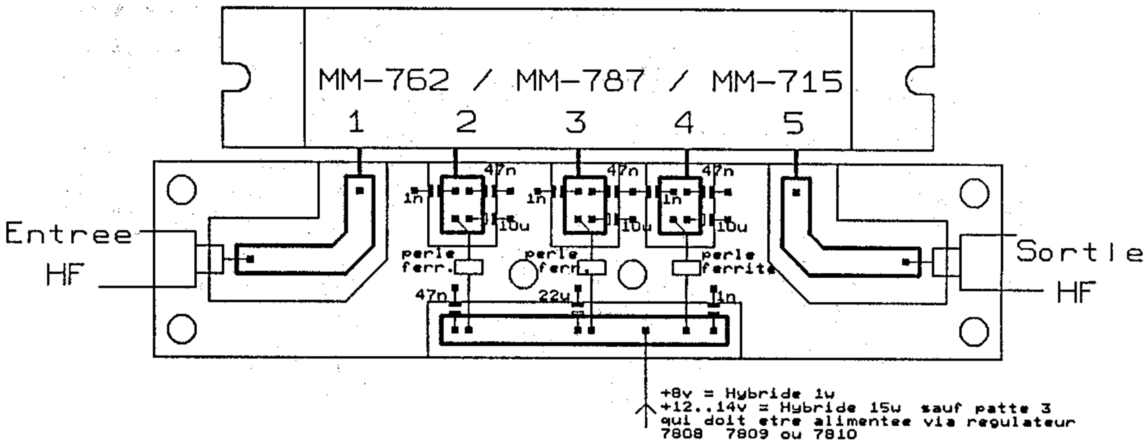


Fig.22: The F3YX 24cm Power Amplifier

Fig.20 also shows the video and audio modulation stages. The video signal should first of all be pre-emphasised, using the network shown in Fig.21, this is because the energy in FM sidebands reduces as the frequency of the modulating signal increases. To this end the signal is passed through a circuit that increases the level of the modulating signal as its frequency increases and is called pre-emphasis. The end result is a received demodulated video signal that does not suffer from HF roll-off and thus suffers no colour degradation. The response of this pre-emphasis circuit should be matched at the receive end with the reverse characteristic (de-emphasis) so as to restore the video response to normal.

The table in Fig.21 shows two sets of values for the components of the pre-emphasis network, one for CCIR and one for the D2MAC system, so you can experiment with both responses, but the correct one to use is CCIR.

The video signal is then amplified by the MH2539 integrated circuit and used to modulate the same varicap diode that is being controlled by the SP 5060 to keep the transmitter on frequency. The frequency lock information is very low frequency information by comparison with the video modulation, and no problems exist when they share the same varicap diode. The level of video deviation is set by RV1, if you do not have enough deviation then reduce the value of the 220 ohm resistor on pin-14 of the MH 2539 to 100 ohms. The 'EQ LINK' (equalisation) is the point of connection of the external pre-emphasis network when it is used. The link must be shorted if no external pre-emphasis circuit is used.

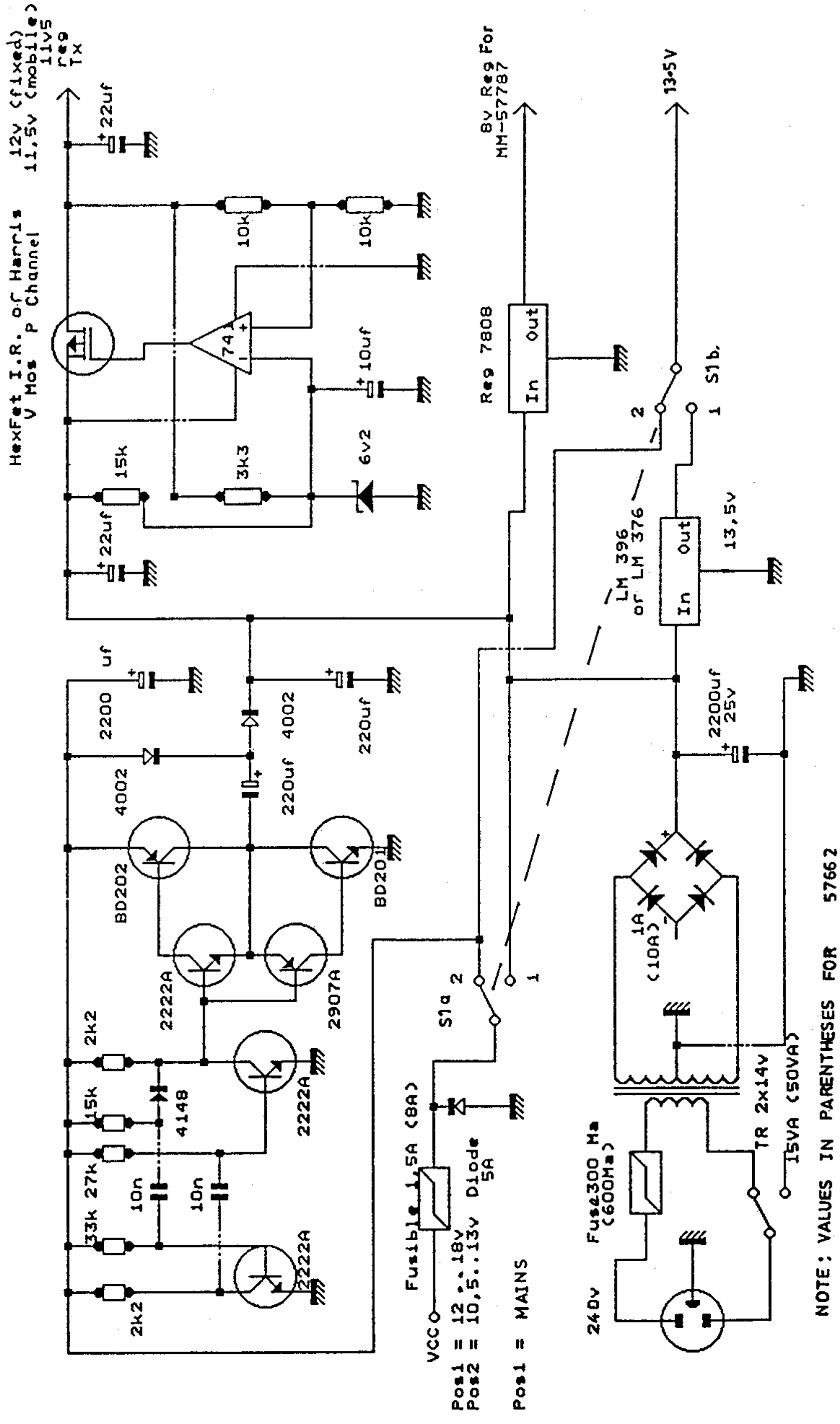


Fig.23: The F3YX 24cm Transmitter Power Supply Unit

The audio side of FM television is very simple and is one of its big attractions. The MC1376 is configured as a sound subcarrier oscillator, the frequency of which is set by inductor L2 and the 330pF capacitor. The frequency of this should be set to 6MHz (theoretically the frequency is 5.9996MHz) for UK work and 5.5MHz for the rest of Europe. To this end it may be best to fit a switch and two trimmers, so that you can switch between sound subcarrier standards.

The audio input is at two different levels, microphone and line. When the microphone input is used the dotted line 'LINK' indicates the connection to the line level input that must be made in order to patch in the additional microphone amplifier stage. The audio gain is set by RV2 and the output level of the sound subcarrier oscillator is set by RV3.

The output from the audio subcarrier oscillator is then mixed with the video signal prior to being used to FM modulate the oscillator. RV3 should be set by decreasing the subcarrier level until the audio signal disappears on a weak path and then increasing until it reappears, plus a small safety margin.

In practice none of the potentiometers are too difficult to set, and once you get the unit up and running reception reports from other amateurs will enable you to set the video and audio deviation along with the audio subcarrier level.

The power amplifier stage is shown in Fig.22. The 57787 device will deliver 1 watt output for a 7mW input, and can then be used to drive the 577621 device, where a power level of 15 watts is easily achieved. The 67715 device can deliver 1.5 watts for a 10 mW input. The selected PA chip or chips need a good heat sync, especially the 577621.

Chip capacitors are used for decoupling PA power inputs along with ferrite beads (perle ferrite on Fig.21)) as per the diagram. The supply voltages are as follows, depending on which chip you choose:

- MM577621 13.3 volts supply and 9 volts bias
- MM57787 7.2 volt supply
- MM67715 8 volts supply

The power supply shown in Fig.23 is again a dual-input unit, so that 12 volt portable operation or 240V AC mains working is possible. S1 is a double pole changeover switch that enables operation from 12 volt in position-2 and 240 volt AC mains operation in position-1.

The DC-to-DC converter selected by position-2 of S1 uses an astable oscillator to invert the 12 volt DC signal in to a square wave signal so it can be voltage doubled, to give a DC level of some 20 volts, which can then be used to derive a 12 volt regulated supply for the transmitter. The regulator is a little unusual, in that it uses a 741 op-amp and a power V-FET. The advantage of the V-FET is that its temperature coefficient prevents overheating or thermal instability. The 12 volts for the MM57762 15 watt PA comes direct from the 12 volt supply and not via the inverter, which is not capable of these power levels.

In position-1 of S1 (mains working) a bridge rectifier is used to provide the necessary DC for the Power amplifiers, which in the case of the 577621 should be rated at 10 amps.

A Remote Control Modular ATV Station

Introduction

This chapter describes a very advanced modular TV station that can be built using a set of printed circuit boards available from BATC Members' Services (Appendix F). The station consists of two main cards, a visual display unit VDU and a central processor unit CPU, which together can perform Teletext decoding, Morse code decoding, caption generation, display the in-built test card and I^2C control menus. These two cards also generate an external I^2C bus of two wires, which provides control over the optional units: vision switcher, relay board and RS232 generator for control of a modem that can put you in touch with the BATC BBS. By being modular you need only build the modules that interest you. The control of these modules is by keyboard operation and a series of menus that help you operate the system. The project is called I^2C because it is built out of a range of integrated circuits that respond to the two wire control system called I^2C.

I^2C came about because of the problems facing IC manufacturers, in that the requirement for external pins is often a limiting factor in design. Also, the more external pins the more expensive the device. The I^2C bus, designed by Philips, is an alternative to escalating the number of pins. It allows ICs to exchange data via two wires. This type of serial communication is particularly suited to slow data exchanges such as is required to control TV hardware. The whole range of I^2C chips are mass produced for the domestic market and as such are very affordable.

The Visual Display Unit (VDU)

This is the display card for the system, it generates TTL RGB video that can be encoded into PAL as discussed in chapter-4, or will drive an RGB monitor direct. It displays all the operating menus for the system. It can be used to generate TV captions in teletype mode and will also decode and display Teletext information and Morse code.

This circuit board contains the SAA5243 and SAA5531 Teletext chip set. The SAA 5243 is controlled via the I^2C bus, and, apart from decoding Teletext information, it can display up to eight pages of information stored in an 8K 6264 RAM chip. Any of the eight pages can be updated whilst a different page is being displayed. The display is fully Teletext compatible (BBC Mode-7 graphics), thus graphics as well as text can be displayed.

The circuit is shown in Fig.1. All the input/output decoding is carried out 'on board' by IC1, IC2, IC3 and IC6. This provides an I^2C bus to control the SAA5243, but the bus may be taken to other I^2C devices as well. In fact, on the PCB there is another I^2C device, IC10, a PCF8583, which is a clock/calendar IC and is battery backed-up, so that the controlling CPU now has a real-time clock facility.

The incoming video is buffered by TR1 and TR2, which provide a high impedance input, so the video may be looped or terminated into a 75 ohm resistor. The buffered video is then routed to IC9, the SAA5231. This device effectively genlocks to the video signal, synchronising all its clocks, and then attempts to extract Teletext data and clock signals from the video signal. If the applied signal contains Teletext information (i.e: from the BBC etc.) then the SAA5243 will be able to decode and display it, providing that the controlling CPU tells it to do so.

Whether the incoming video contains Teletext information or not, the board is now genlocked to the signal, and the Red, Green and Blue outputs from the SAA5243 will be in synchronisation. So, all that is required now is a PAL coder as described in chapter-4 and you will be able to display the I^2C menus, but only if you have the CPU module connected, as the VDU will not function without it. The SAA5231 need not be fitted to the PCB if Genlock or Teletext decoding facilities are not required. The links should be set as per the notes on the circuit diagram (Fig.1) depending on whether this device is fitted or not.

Construction

The circuit diagram of the Video Display Unit is shown in Fig.1, with a component overlay in Fig.2. The PCB is through hole plated Eurocard and will accept a DIN 41612 connector. The only specialised ICs are the SAA5243 and the SAA5231, but details of suppliers of these devices will be forwarded with the PCB from BATC Members' Services (Appendix F).

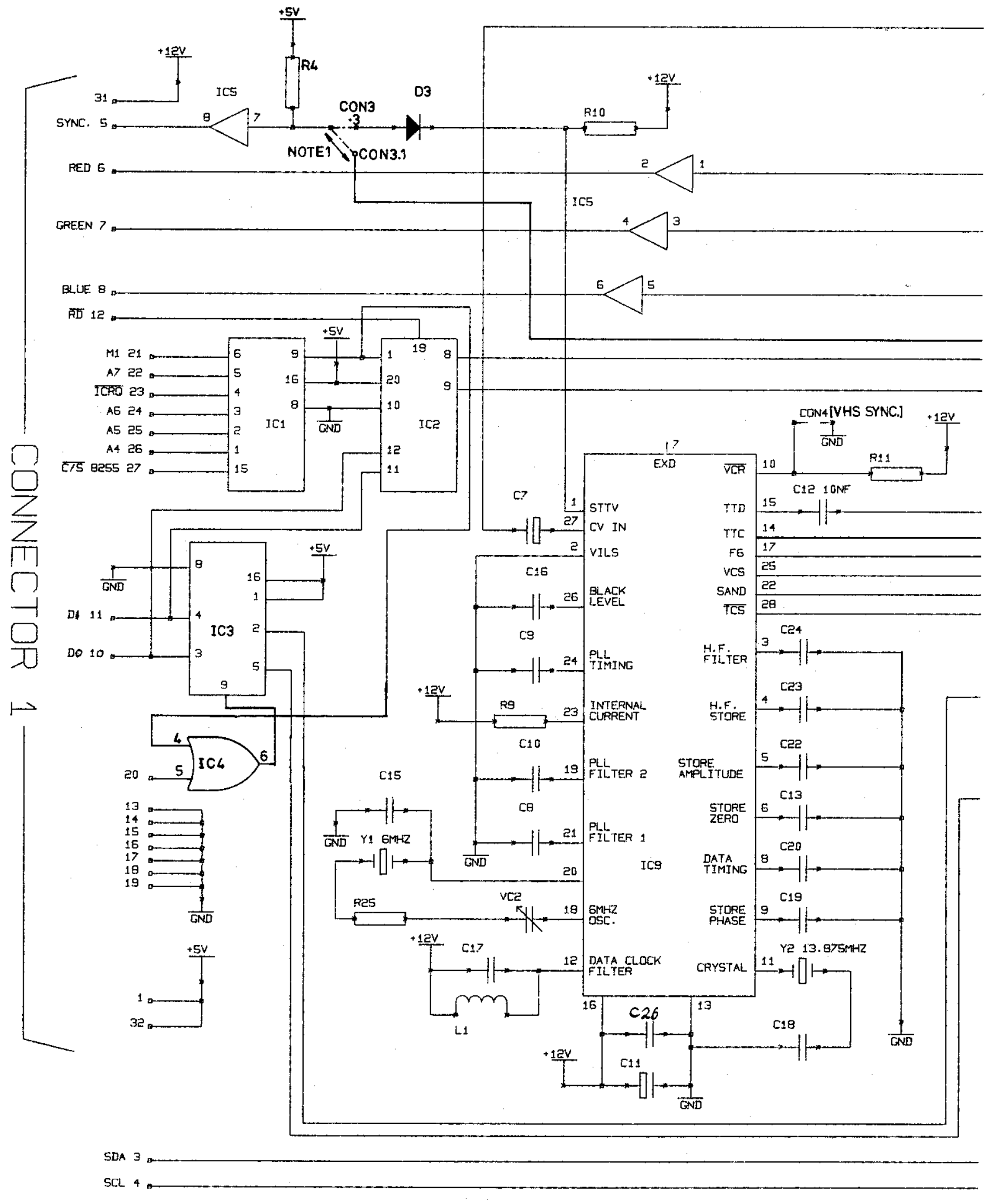
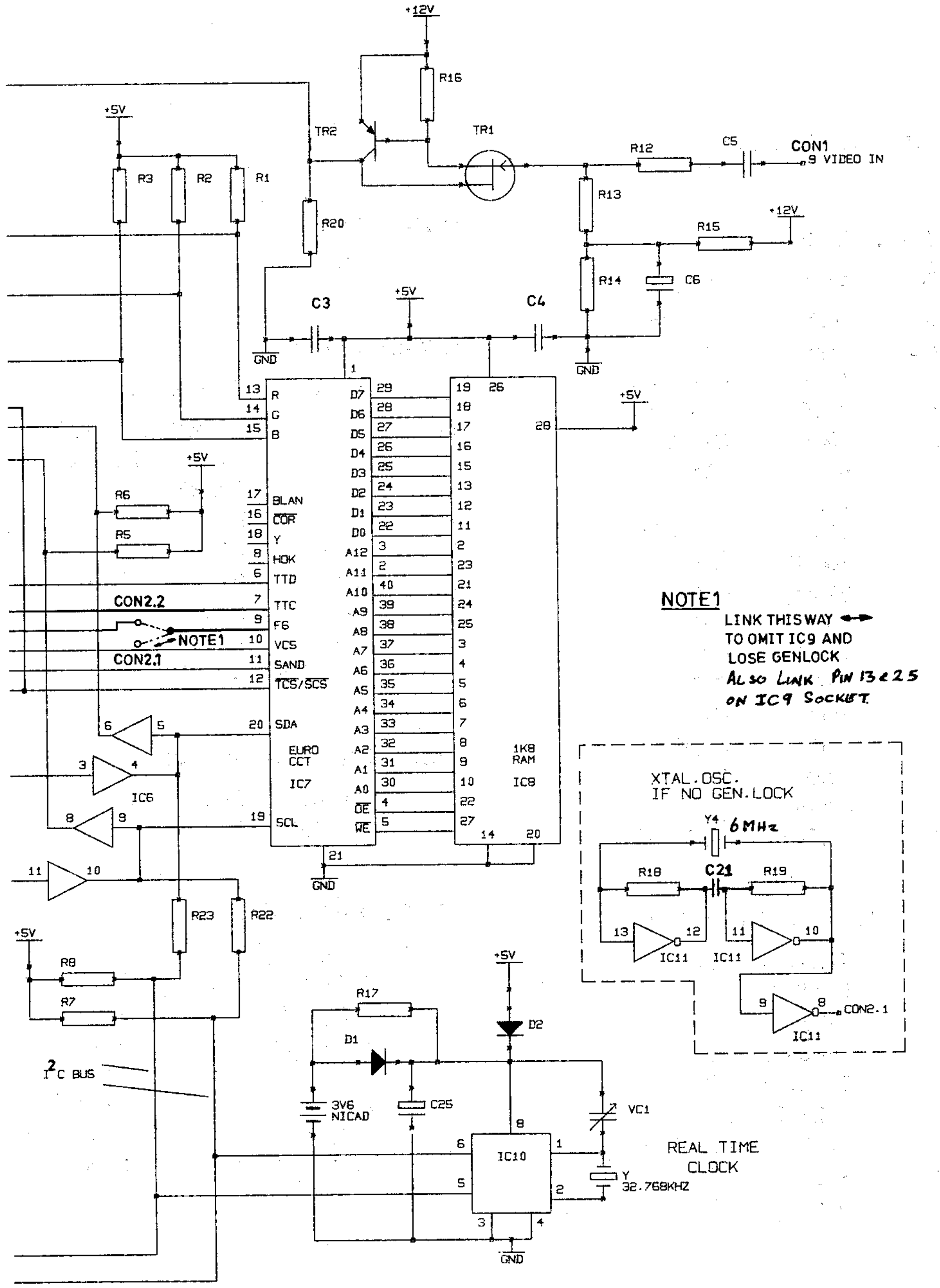


Fig.1: Visual Display Unit Circuit Diagram

Card Interconnect

The PCB cards are in a format known as Euro-card, and as such they are a standard size for housing in a card frame. The edge connectors are called DIN 41612 and are indirect edge connectors, i.e: they come in two parts; a plug which solders directly to the PCB, and a socket which it plugs into. They are available with a choice of one, two, or three rows of connectors (a, b and c), and there are 32 pins in each row. They also have two kinds of plastic housings, one that only allows for two rows of connectors, and one that will take all three.

It is suggested that the type with the wider mouldings is used incorporating a connector having three row of pins. This is not necessary for any of the cards yet designed or planned for the future, but allows us to set a standard at the outset, which will mean that cards from any one system will plug into another, useful for testing and fault finding. Also, the use of an extender card is extremely helpful when working on racked card systems such as this, and if you standardise on one type of connector system you will only need one type of extender card.



The diagram in Fig.3 shows the interconnections between the VDU card and the CPU card. Unfortunately, try as hard as we did we could not avoid a design that has some wires crossing, the cards are quite small and the circuits complex. The a, b and c rows are identified on the plugs and sockets, as are the pin numbers, but you do need 20/20 vision or strong glasses to see them. The wires between the cards should be kept as short as possible and the cards should ideally be mounted vertically, as is the case in a card frame. The power supply needs to be ‘clean’ and well regulated. The only external connections are to the monitor, keyboard, and video input (which is only required for Teletext or genlocking), the power supply and the I^2C bus (SCL and SDA), which is the interconnect for all forthcoming modules and any commercial I^2C equipment.

The Central Processor Unit (CPU) Card

This card is the brains of the system. It is where the Z80 microprocessor is to be found, along with the RAM and EPROM memory, where all the software instructions that run the system are stored. The CPU circuit evolved from the original Teletron CPU, which appeared in the BATC publication ‘Micro and Television Projects’. The CPU is shown in Fig.4 and the component overlay in Fig.5. Like the VDU circuit board, this board is through-hole plated, so IC sockets can be fitted for all the chips. There are several link connection options on the PCB and these are as follows:

CON2 - should be made so that pin-6 of the 8255 is routed to B31 of the 41612 edge connector.

CON3 - should be made A-C because we are using a 62256 RAM chip.

The other connection configuration of CON2 allows the CPU to be used independently of the VDU, and the other configuration for CON3 allows the use of the smaller 6264 RAM chips to be used for less ambitious projects.

The back-up battery, B1, is a luxury and need not be fitted in this application. The interconnection diagram in Fig.3 shows how to connect the two cards together and also how to add an ASCII keyboard to drive the system.

IC6 is a pre-programmed EPROM containing the I^2C software (see Appendix F), if you have a callsign please state it when ordering this EPROM and it will be incorporated into the in-built test card. When the EPROM is fitted the two units can be powered up and, if all is well, the start-up menu will appear on the monitor. This is irrespective of whether a keyboard is connected or not.

The video signal produced by the VDU module can be connected to an RGB monitor, the RGB Switcher, or to the PAL coder described in chapter-4.

The keyboard should be an ASCII type and have a negative strobe. Most keyboards have a strap facility for selecting the strobe polarity, if yours does not and is of the incorrect polarity, then you will have to add an inverter chip.

It should go without saying that you will not get a menu on the screen, or even a sync pulse out of the unit, if you have not fitted the custom EPROM IC6, and correctly wired and populated both the CPU and the VDU cards and the interconnects.

VDU Parts List

Capacitors:

Qty	Value	Components
3	10nF	C1, C25, C3
2	l8pF	C10, C15
3	l0uF	Cl1, C12, C6
2	22nF	C13, C26
2	l0nF	C14, C2
1	68nF	C16
1	27pF	C17
2	l5pF	C18, C24
1	l00pF	C19
1	270pF	C20
1	l0nF	C21
1	470pF	C22
1	lnF	C23
1	l0nF	C4
2	luF	*C5*, C7
1	47nF	C8
1	220pF	C9
2	3-22pF	VC1, VC2

Inductors:

1	**15uH**	**L1**

Resistors:

Qty	Value	Components
14	4k7	Rl, Rl0, R1l, R12, R13, R14, R15, R16, R2, R3, R4, R5, R6, R9
1	1k0	R20
1	330	R25
3	1k5	R26, R27, R28
2	3k3	R7, R8
2 Wire Link		R22, R23

Transistors & Diodes:

1	2N3819	TR1
1	2N3906	TR2

Integrated Circuits:

1	74LS 138	IC1
1	PCF8583	IC10
1	74LS04	IC11
1	74LS541	1C2
1	74LS174	1C3
1	74LS32	1C4
2	7417	1C5, 1C6
1	SAA5243	1C7
1	6264	1C8
1	SAA5231	1C9

Miscellaneous:

1	6MHz Crystal	Y1
1	8.75MHz Crystal	Y2
1	AB_EURO	CON1
3	3-pin Header	CON2, CON3, CON4
3	1N4148	D1, D2, D3
1	3.8V NICAD	NICAD

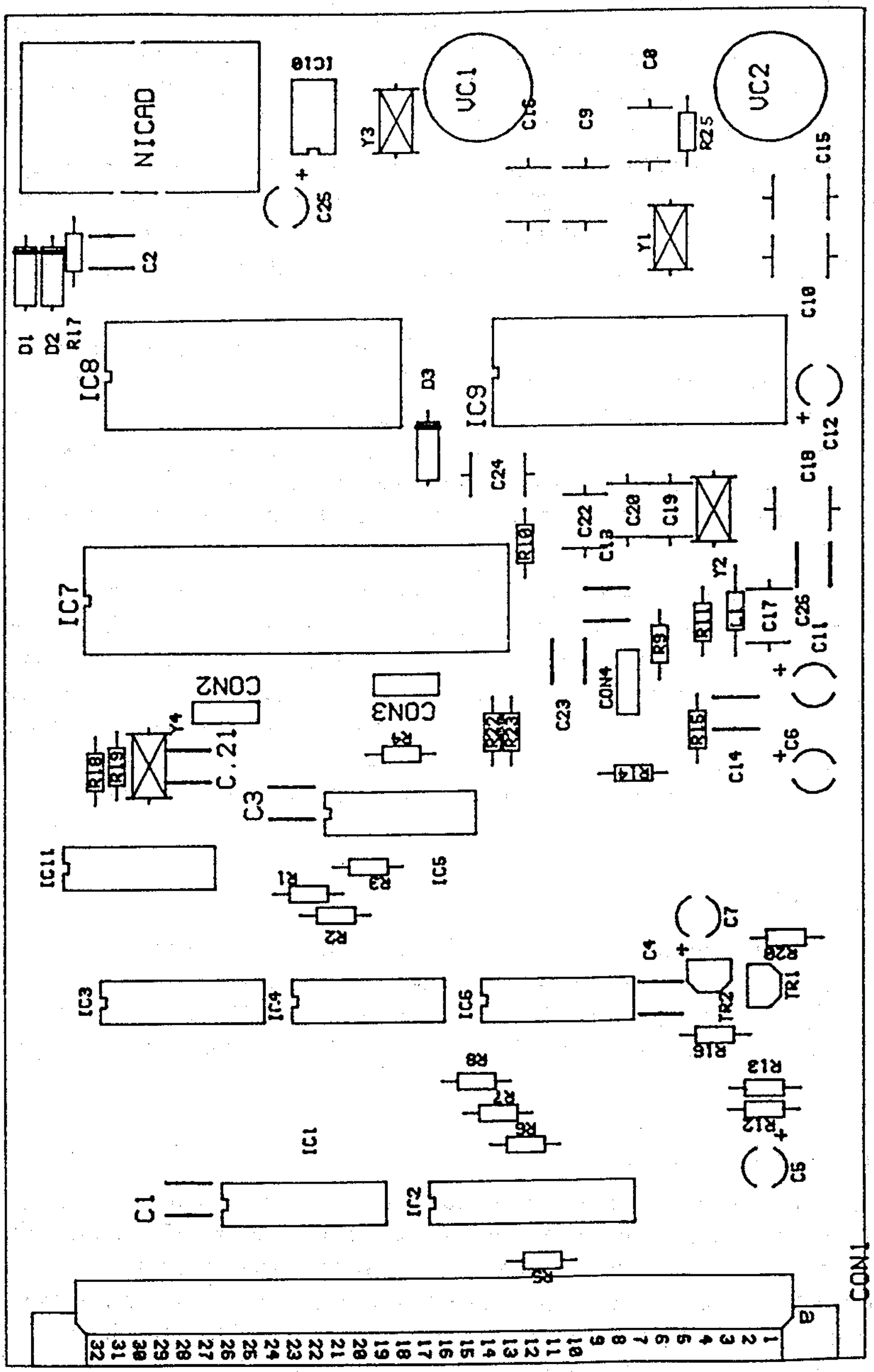


Fig.2: Visual Display Unit Component Overlay

The Video Switcher

This is the first optional card in the system and performs video switching to a very high standard. It has been designed as an eight in, two out board. This means that you can feed up to eight composite video signals into the board and each of the two outputs can be connected to any one input, independently of the other.

The circuit features vertical interval cutting and broadcast quality performance.

The circuit diagram is shown on two double pages in Fig's.6a and 6b, and at first sight may appear rather complex, but don't be discouraged as this is not so. Further study of the circuit diagrams reveals that there are four parts to the circuit:-

A) Input stage

B) Channel select

C) Video amplifier

D) I^2C decode and latch

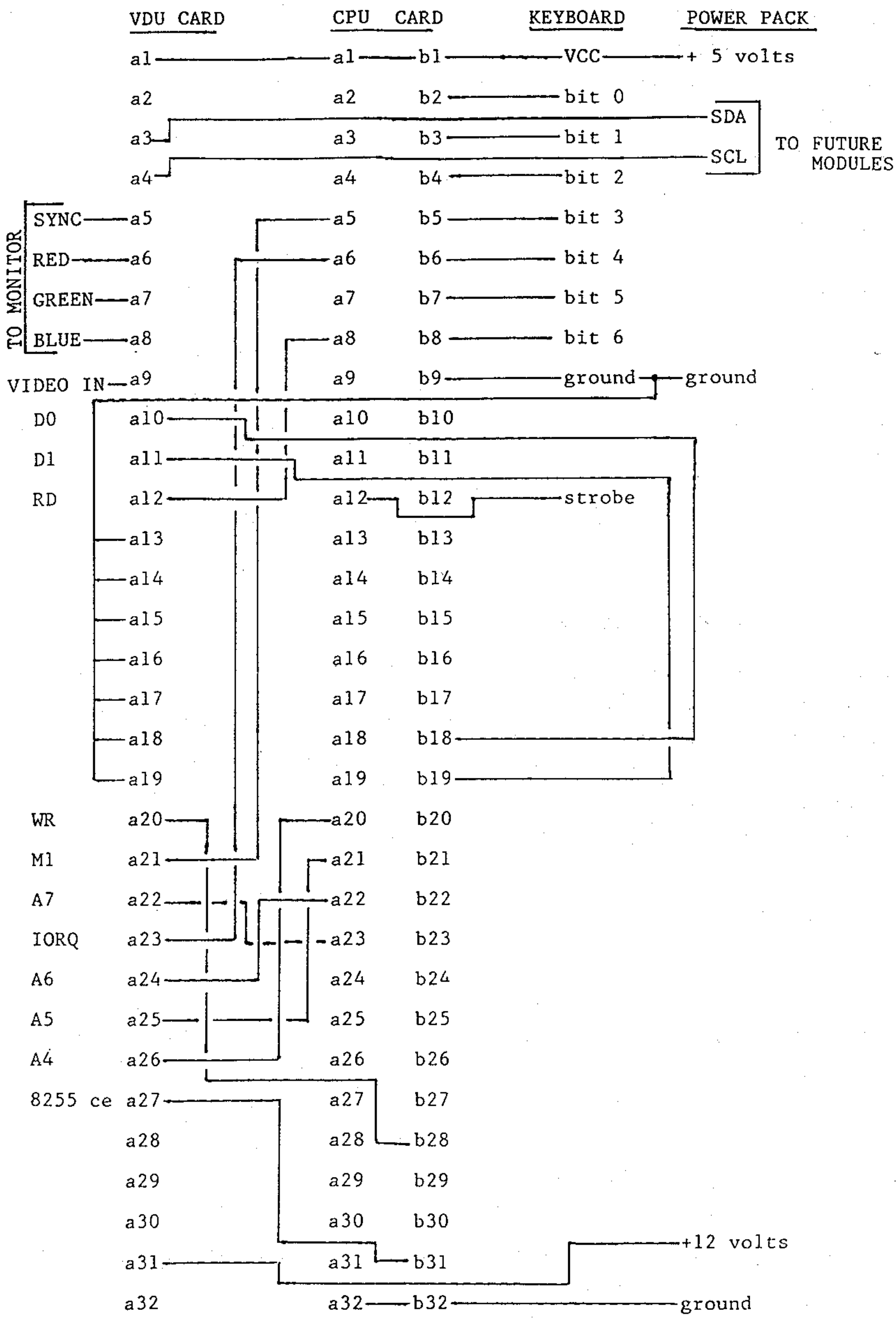


Fig.3: VDU-CPU Card Interconnect Diagram

Circuit Description

There are eight identical input circuits. The purpose of these is to buffer the incoming video and provide a high impedance input to the board, so that more than one board may be strapped together and so that the video signal can be either looped or terminated.

The video signal is fed in via the 6.8uF DC blocking capacitor, and onto the gate of the FET. The PNP transistor wired across the FET linearises it. The output from the FET is then fed to the video switch ICs. The DC bias for the FET is fed to its gate via the 1M resistor. This bias signal is derived from two places:

1) Firstly the ‘no signal’ condition forces the output to zero volts because the 6V8 Zener diode biasses the FET to the correct point, at this point the second PNP transistor is switched off.

2) Secondly, when video is present, the sync tips will turn on the second PNP transistor, effectively clamping the sync tips to the reference voltage fed to each input stage.

This form of clamp works better than the more familiar ‘diode clamp’ as it only clamps the sync pulse, without affecting the rest of the video signal.

The outputs of the clamps feed the GX414 four channel video selector ICs. These have their inputs wired in pairs, i.e: IC1 and IC2 have channels-1, 2, 3, and 4 as their inputs, and IC3 and IC4 have channels-5, 6 ,7 and 8 as inputs. The outputs of IC1 and 3 are commoned via 22 ohm resistors to feed one video amplifier, and IC2 and IC4 feed the second video amplifier.

The two video amplifiers are identical. The input signal is fed via a damped inductor to the base of TR3. This point is shunted to ground by a variable capacitor to set the HF roll-off of the video amplifier. The damped inductor sets the bandwidth of the amplifier and also counteracts the effect of a rather nasty peak in the response of the GX414 switches.

The inverted signal at the collector of TR3 is fed to the base of TR8 (VC1 allows the response to be trimmed flat) where it is once more inverted and fed to the bases of the output pair, TR9 and TR16, with D4 adjusting the DC conditions for these two transistors, which are configured as complementary emitter followers. The output point is fed back to the emitter of TR3 to act as a bias stabilising network and the gain of the circuit is set by RV2. The output of the video amplifier is fed via a 75 ohm resistor to present the correct impedance to the outside world.

The two I^2C signals (SDA and SCL) are fed to IC6, which decodes the data into eight outputs. These are fed to an octal latch IC5, which stores the data sent over the I^2C bus. These signals enable the GX414’s and decide which inputs are connected to which outputs. The data is clocked into the latch during the vertical interval, so that the picture will not ‘jump’ when switched.

The vertical interval is detected by IC7, an LM1881 sync separator. The vertical pulse output is fed to the clock input of IC5, the latch. The other enable input to IC7a is fed from the I^2C bus chip IC6 and provides a ‘GO’ signal to activate the switching process.

The four DIP switches set the I^2C address at which the switcher sits, so that if more than one switcher is required then separate control over them is possible, by moving the switches to different positions.

The input to the sync separator has been brought out via the connector so that it can be fed from which ever source you want rather than being connected to channel-1. If it is fed from any other source than one of the sources fed to channels-1 to 8, then it will need to be terminated on the connector into which the card plugs with a 75 ohm resistor.

Construction Notes

One point about the construction. The through-hole plated printed circuit card (Appendix F) is quite densely populated, and whilst it is possible to use quarter watt resistors for the clamp circuits it will look neater if you can use one eighth watt types.

The Relay Board

The relay card is the second optional module, and is a set of I^2C controlled relays that enable the I^2C system to be able to control parts of the external world, such as turning transmitters on and of, rolling VTR machines, etc.

All of the contacts of the eight relays are brought to the edge connector for use as required. Each relay is a double-pole change-over type and provision has been made for pull up or pull down resistors (or links) on the normally open, and normally closed contacts.

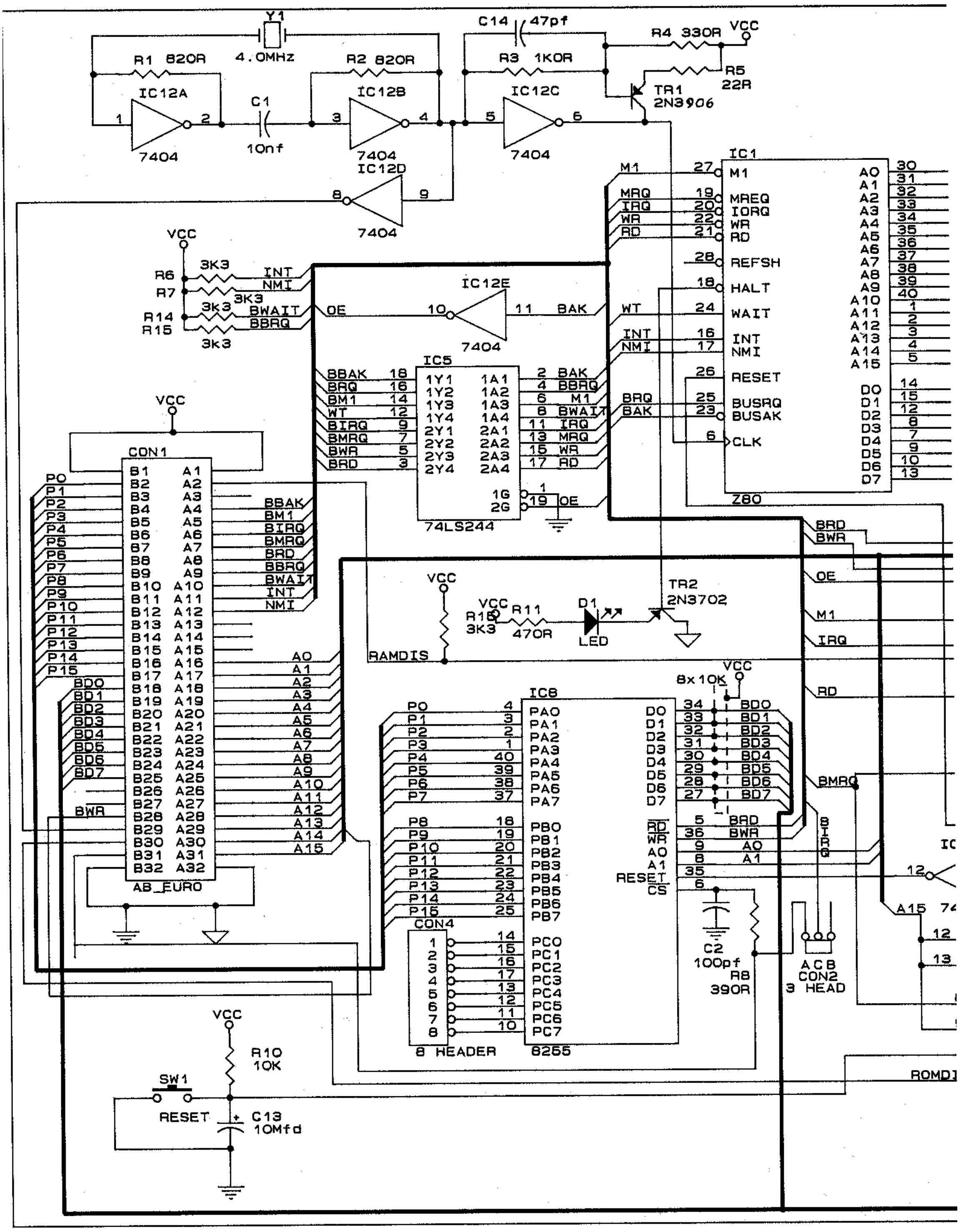
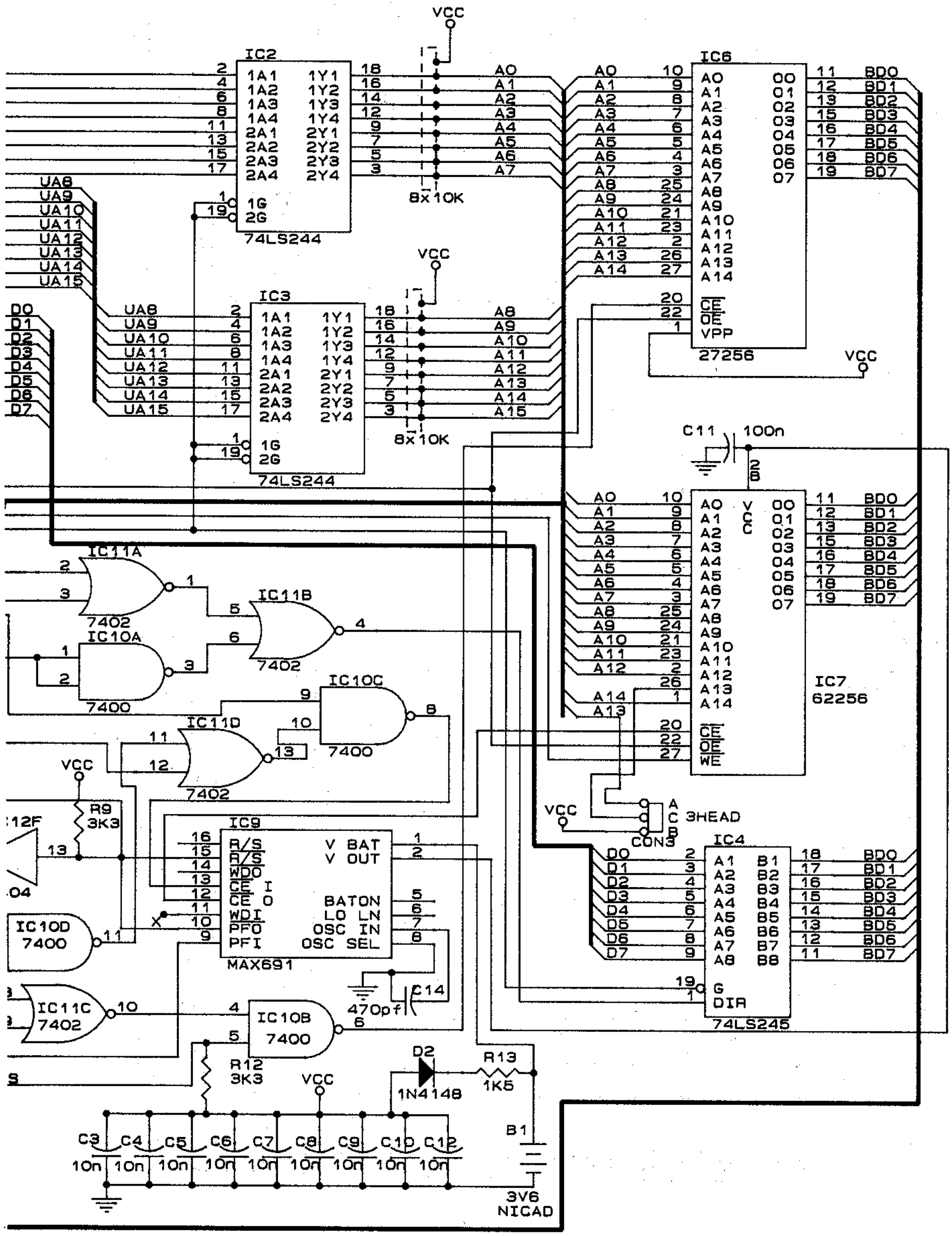


Fig.4: Central Processor Unit Circuit Diagram

The circuit, shown in Fig.7, consists of a PCF8574A eight bit port integrated circuit (IC2), which can be set to one of eight possible addresses by the setting of the three switches on the A0-A2 inputs.

The eight individually addressable 'bits' are each connected to a section of IC1, a ULN2803. This is an octal relay driver IC which has built in protection diodes to protect against the back EMF from the relays when they are de-energised.

WARNING: The relays are only rated at 1Amp at 115 Volts, so MUST NOT be used to switch mains voltages direct.



Components

A component overlay for this unit is shown in Fig.8. The relays are standard 12 Volt, PCB mounting double-pole double-throw types manufactured by OMRON and are available from Farnell (part No.179-351), RS Components, and several other suppliers. (Appendix E).

There are 32 pull-up/pull-down resistors shown on the circuit diagram. They are only shown for guidance and it is only necessary to fit them if they are required by the input circuitry of the device that is being controlled by that particular relay.

The Serial Port

This is the third optional module and will put two RS232, serial ports at your disposal. How you use them will be up to you, they are configurable either via a menu option or by programming them yourself, via Z80 machine code.

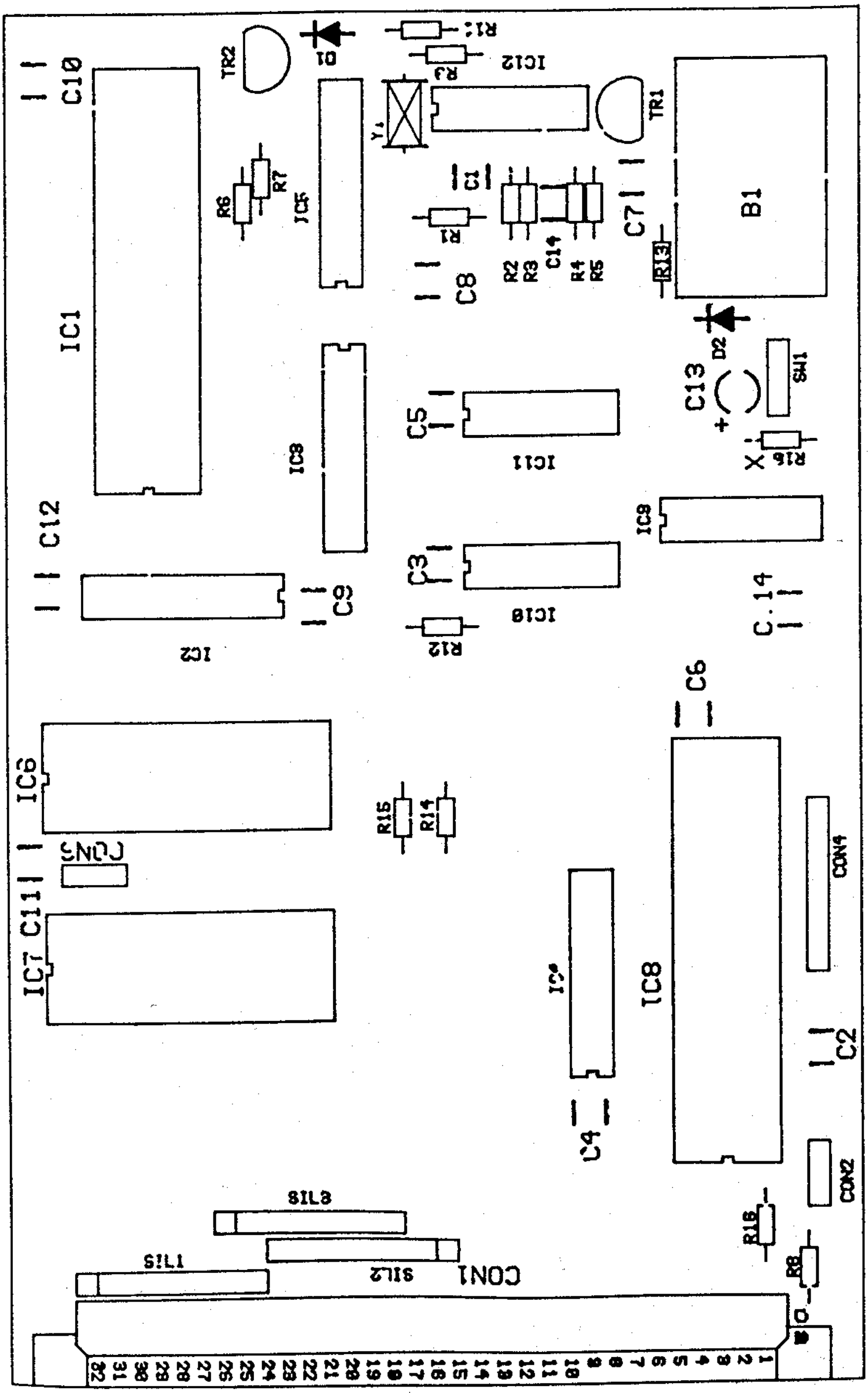


Fig.5: CPU Component Overlay

The main idea behind the card was to encourage more people to build the system. Providing an uncommitted serial interface will allow you to connect any equipment that has an RS232 port to the I^2C computer.

The most popular piece of hardware that uses a serial port, is a modem. 300-300 Baud modems can be found at very reasonable prices at rallies nowadays and once connected to the system they can be controlled with the terminal emulator.

This means that you can then call the BATC Bulletin board on 0767 317521! Most bulletin boards assume you have 80 columns of text across your screen. Of course this is not the case with the I^2C system, it has only 40. But do not despair, the BATC BBS can work in 40 columns just ring Chris Smith on 0767 313292 before you log on for the first time and ask him to set it up for 40 columns for you, the BBS will remember you are a 40 column user from then on and will always present you with the correct display.

Circuit Description

Figure 9 shows the complete circuit diagram of the board. It is not a very complicated board and could be built on a Eurocard size piece of Veroboard in an evening.

IC1 is a 74LS04 device and two of its inverters are used to form a crystal oscillator, the output is buffered by a third inverter and fed to two pins on IC2.

IC2 is a Z80 CTC (Counter/Timer Circuit) and is used to generate the correct frequency clocks to drive the serial device. IC2 has four internal counters, two are used to provide clocks for the serial interface (T1 & T2). The other two counters are uncommitted and may be programmed to do whatever you like. They always count down, so you put a number into them and they will decrement that number until it reaches zero. Once they reach zero, they can INTerrupt the CPU (If programmed to do so). In addition to being able to count the CPU clock, they can be set up to count external events as well.

The two outputs from IC2 drive the clock inputs of IC3. This is a Z80 SIO device (Serial Input/Output). It can be programmed in a whole host of different modes, including :-

Asynchronous - 5, 6, 7 or 8 bits/character, Variable stop bits, Several clock rate multipliers, Break generation and detection, Parity, Overrun and Framing error detection.

Synchronous - Bit or Byte orientated messages, 5, 6, 7 or 8 bits/character IBM Bisync, SDLC, HDLC, CCITT-X.25, etc. Automatic CRC generation/checking, Sync character and Zero insertion/deletion, Abort generation/detection and Flag insertion.

The terminal emulator will allow you to use it in Asynchronous mode at either 300, 1200 or 2400 baud. The device itself can go up to 800K bits/second, but the I^2C VDU limits the maximum speed at which characters can be transferred from the serial port onto the screen. The maximum clock rate for the I^2C bus is 100kHz.

The serial I/O from IC3 is converted to RS232 levels by IC4&5 for port one and IC5&7 for port two.

The card requires +5volts to power all the TTL devices and +/-12 volts for the RS232 driver chips.

This completes the BATC I^2C construction projects produced at the time of writing this book. However, there are likely to be several more units to be designed and these will appear as supplements with future issues of CQ-TV.

This system of 2-wire control is extremely versatile and it is likely that you will come up with ideas of your own on how you can utilise the system. A description of the software follows in the next section.

The Firmware Operating System

his final section in this chapter explains the facilities and use of the I^2C firmware (Version 2.3), which is supplied in a 32k Byte EPROM (27C256) from BATC Members' Services, and contains all the code necessary to run the I^2C projects covered so far.

The software provides a menu driven environment enabling full access to all of the I^2C projects. For those of you who require more control than the menu system provides, there is an operating system called TOS (Teletron Operating System). This is accessed by the first selection from the main menu and provides a machine code monitor type environment, with the more familiar command line entry and prompt.

The commands recognised from TOS are as follows :-

CALL CLS DATE DISASSEMBLE EXAMINE FILL IN DOWNLOAD MENU MODIFY OUT REGISTERS SEARCH TIME

Each of these commands are described in full at the end of this section.

The menu system is very easy to use, simply press the key indicated by the menu options. From the main menu, you have eight choices:-

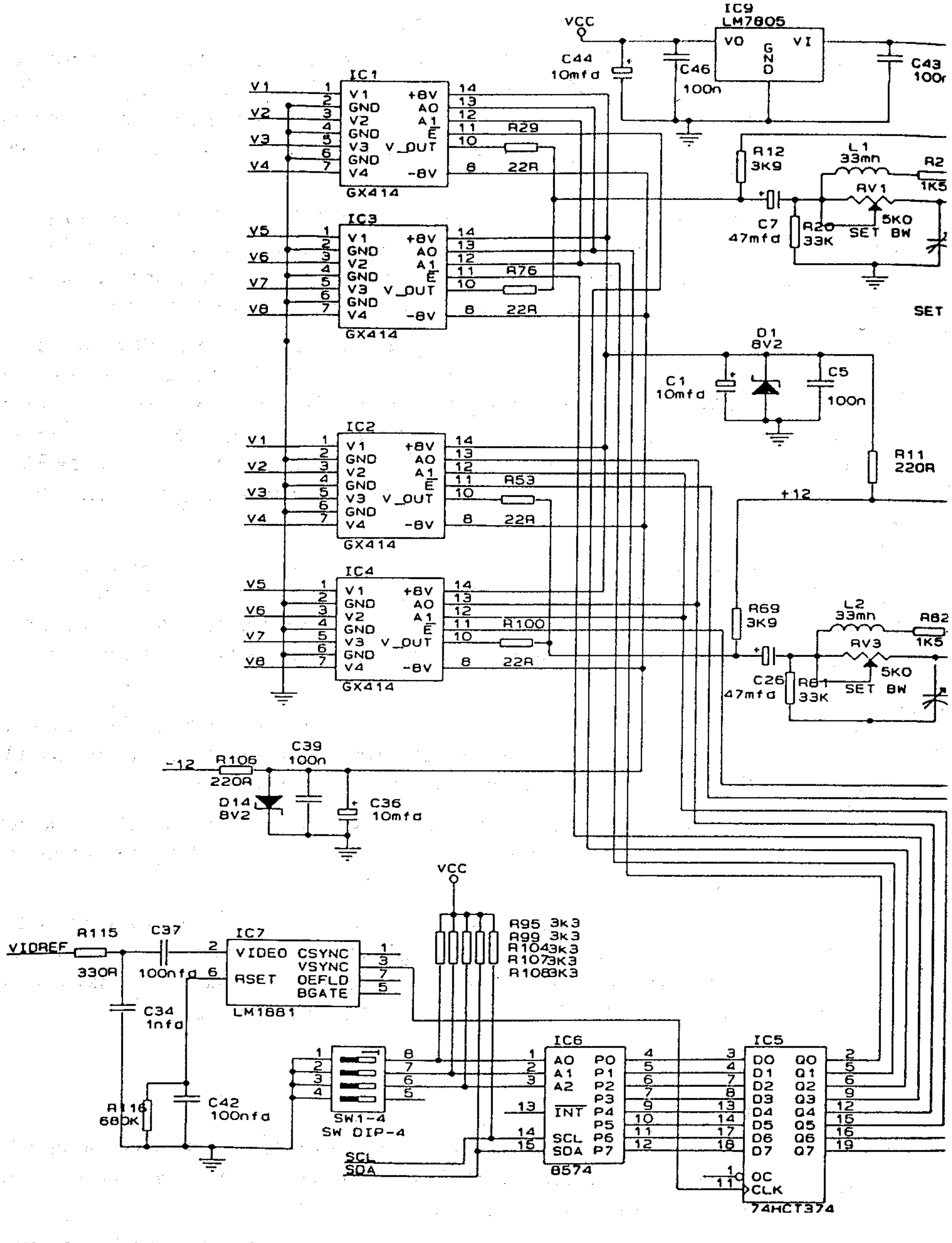


Fig.6a: Vision Switcher Circuit Diagram Part-1

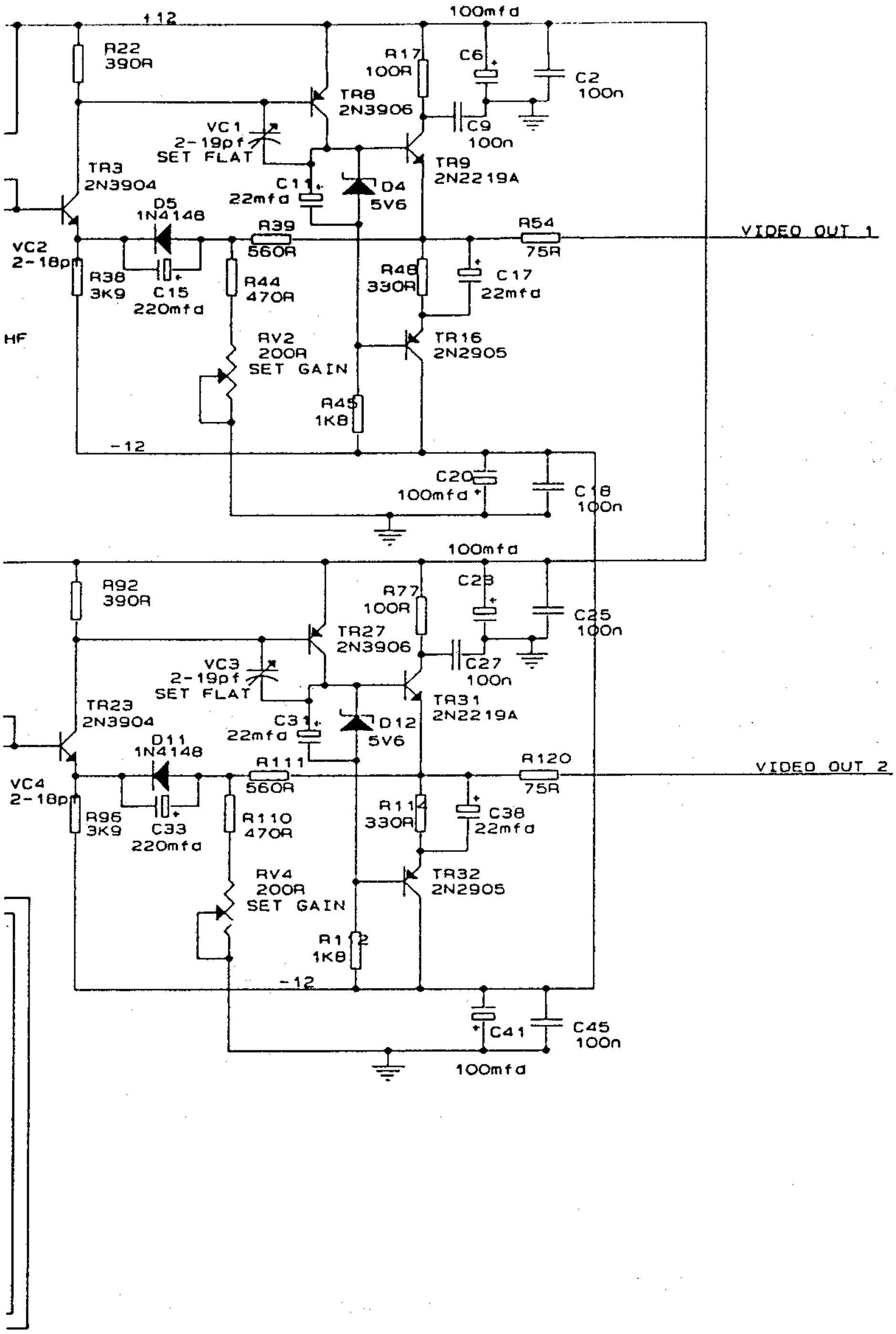
1 - Exit to TOS. This places you in the machine code monitor, described at the end of this document.

2 - Set date and time. This option allows you to set the correct date and time for the real time clock chip. You simply enter the correct date and time then press return. If you want to exit without altering anything, press ESCape.

3 - Enter TELETYPE mode. This places you in the teletext editing mode. You are presented with a blank screen. At this point you can start typing, anything you type will appear on the screen. The cursor keys allow you to move around the screen without disturbing anything. There are also some control characters available, these are generated by holding the CONTROL key down whilst pressing a letter from A-Z.

The control characters available are:

CTRL-D Turn cursor on



CTRL-E Turn cursor off

CTRL-H Move cursor left (same as left cursor key)

CTRL-I Move cursor right (same as right cursor key)

CTRL-J Move cursor down (same as down cursor key)

CTRL-K Move cursor up (same as cursor up key)

CTRL-L Clear screen and cursor home

CTRL-M Move cursor to start of current line (Carriage return)

If you press the ESCape key at any time, a menu will appear at the foot of the page. If you press ESCape again, you will be returned to the main menu, Otherwise you may now enter one of the following commands:

Save - Save the current screen to RAM

Load - Load from RAM to screen

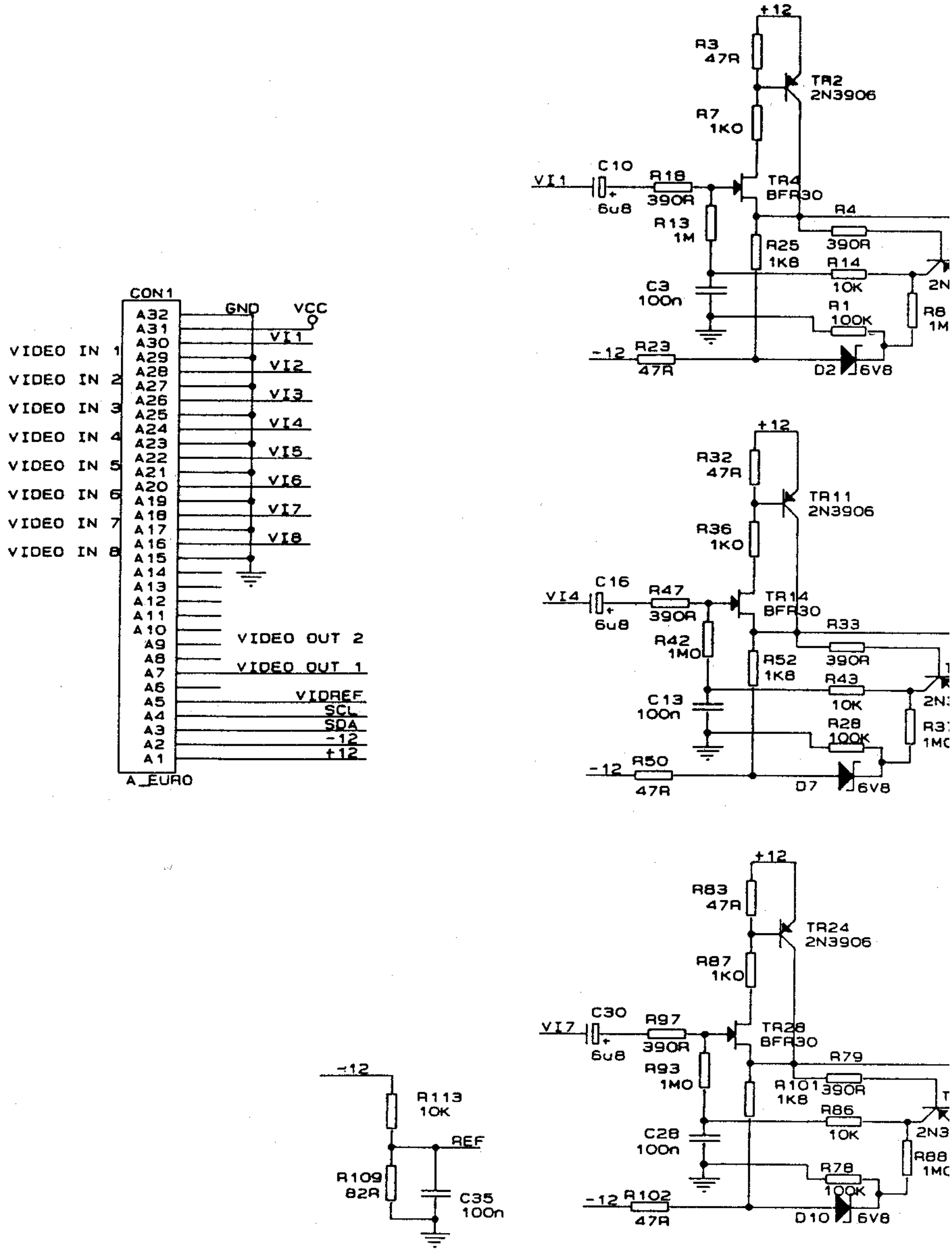


Fig.6b: Vision Switcher Circuit Diagram Part-2

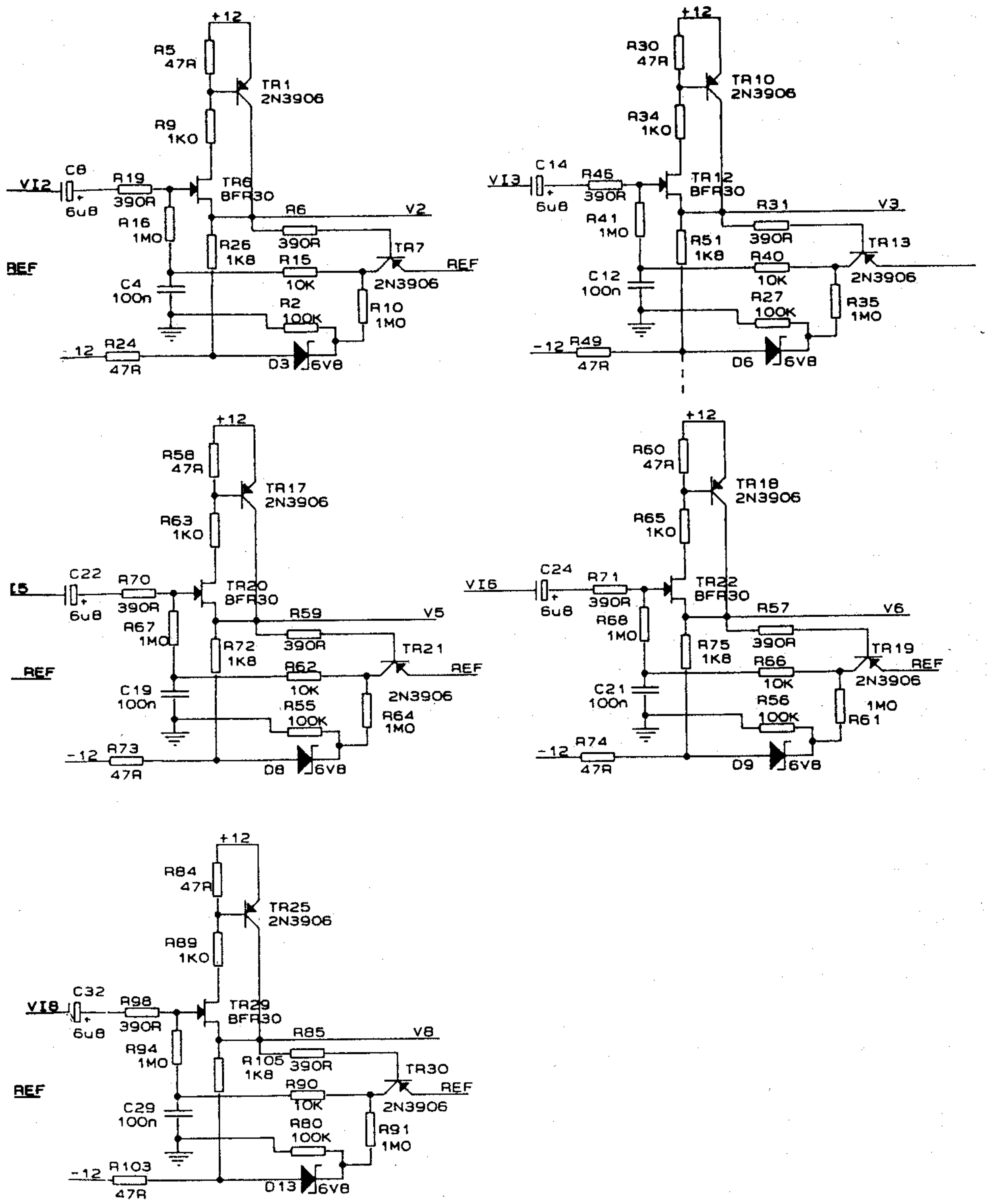
Hex - Enter a two digit HEX number, which will be deposited at the current cursor position. This allows you to generate colour and graphics.

Top - Displays the top half of the screen in double height

Bottm - Displays the bottom half of the screen in double height

Norm - Returns the display to normal height

Graphics - Allows easy generation of graphics. If the cursor is at a position on the screen that is in graphics mode, this command will let you build up the graphics block. You toggle the pixels on/off by pressing ‘1’ and ‘2’ for the bottom row, ‘4’ and ‘5’ for the middle row, ‘7’ and ‘8’ for the top row. If you see characters appearing when you use this command, then you where not in graphics mode. Use the Hex command described above to place a graphics colour code at the start of the current line.



For further reference on how to produce graphics on a Teletext system, see CQ-TV 154 Page 23.

4 - Display inbuilt test card. There is a test card programmed into the operating system, with your callsign in. Press ESCape to return to the main menu.

5 - Enter system control menu. This displays another menu, each option on the new menu allows you access to the I^{2}C projects. A detailed description follows later.

6 - Teletext acquisition. This option allows you to capture teletext information off air. When you first enter, page 100 will be requested. After a short delay, if all is well, this will be displayed. The menu on the bottom line is always present and the following commands may be entered at any time:

ESCape - Return to the main menu

Hold - Places the current page on hold.

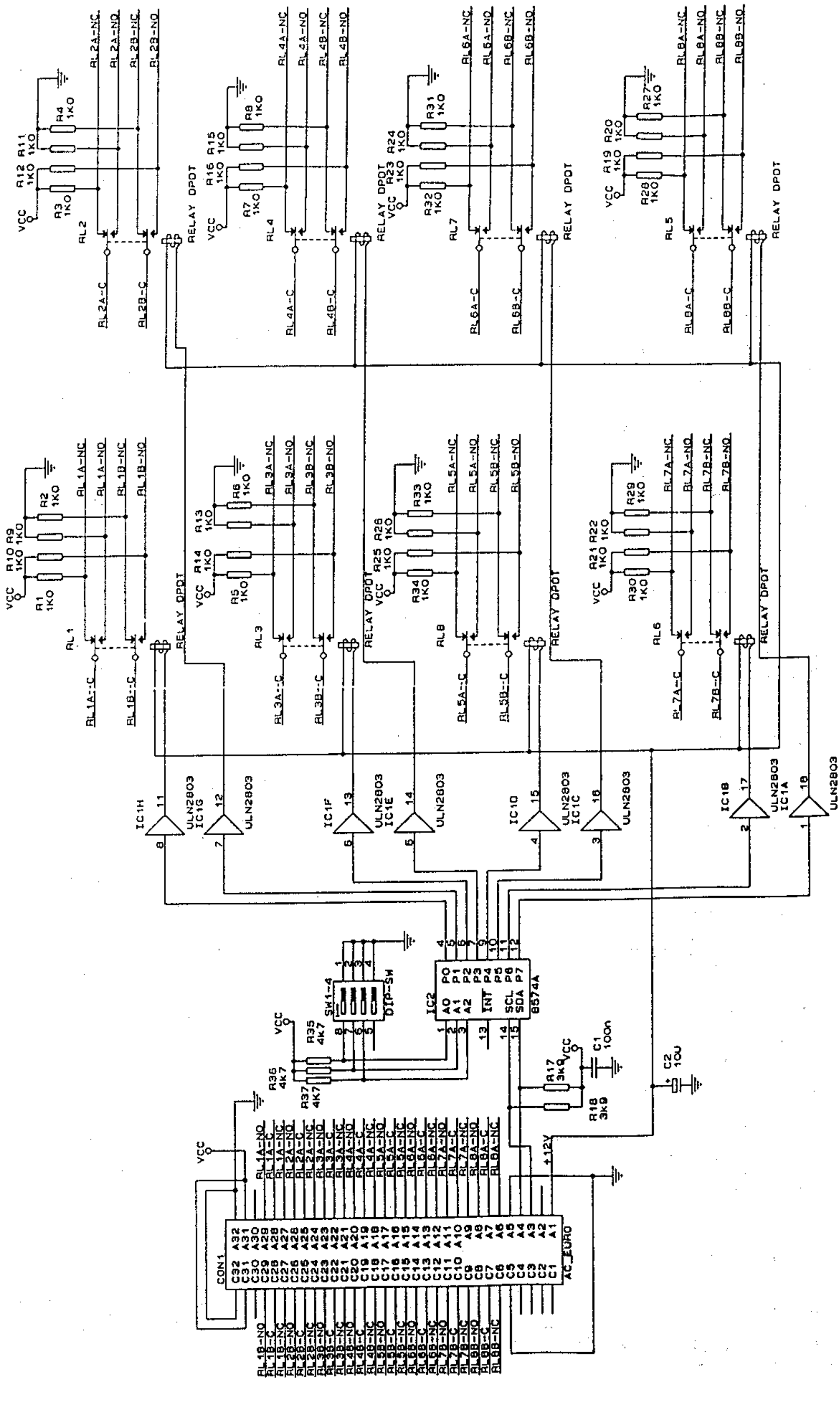


Fig.7: Relay Board Circuit Diagram

Page - Enter a new page request. This is in the form of a three digit number. The software will accept full HEX numbers, although the broadcasters only transmit the decimal pages normally. You may also enter the letter ‘X’ in any digit position, this will set that digit to ‘don’t care’ the result being that the acquisition circuits will accept any page number for that digit. The results of this are quite spectacular if you enter ‘XXX’ in other words, display ANY page.

Save - Save current page to RAM. NOTE - The area of RAM used to ‘save’ is the same area used by the TELETYPE option. Thus you can save a teletext page, then ‘load’ it into the TELETYPE screen and edit it.

Timed-page - Enter a four digit HEX number to request a timed page. i.e: When teletext transmits a page, it may send page 1 of 4, then 2 of 4, etc. If you enter 0001 here, it will only display page 1 of 4. This will contain all X’s by default, which means all timed pages will be shown.

Ident - Displays the broadcasters identification packet on the status line. The menu disappears while this is being done, press any key to get the menu back.

7 - Morse code decoder. This option is a full morse code decoder, it looks for morse on bit 2 of port C of the 8255 chip. You can connect a morse key and practice your morse, or attach a tone decoder and ‘read’ Morse off air. The port should be normally high (3k3 pull-up resistor) and go low when the key is down, or tone present. The input is via pin 3 of connector 4 on the CPU card. Connector-4 is located directly below IC8 (8255) and can be extended to the main edge connector using one of the spare pins if you so desire.

If you want to expand the system FOR decoding Morse received over the air then you will need a tone decoder circuit. This can be achieved using an NE567, which will convert the tone to a logic level suitable for connection to pin-3 on connector 4.

8 - Terminal emulator. You will be presented with a blank screen, anything you type will be sent to port one on the serial card, anything that is received from port one will be shown on the screen. The software defaults to 300 baud, 8 bits/character, 1 stop bit and no parity. You can alter these settings by typing CONTROL-A. This will stop data transfer over the serial port and present you with a menu of options. Select the option you require by pressing the number next to that option. This will then re-program the serial port to your requirements and carry on with the terminal emulation. (There is also an option to quit back to the main menu).

Option 5 on the main menu takes you to another menu. This menu allows you to control all the I^2C projects described in this book.

1 - Return to main menu

2 - Relay control. This allows control of the eight channel relay card. When selected, you are presented with another menu, with the following options:

1 - Return to previous menu. This option takes you back to the previous menu

2 - Redefine inputs. This option allows you to give each relay a unique label. The default labels are ‘RELAY 1’ ‘RELAY 2’ etc. You may alter these with this selection. After pressing ‘2’ you will be asked which relay you wish to alter 1-8. Press a number between 1 and 8. You will then be prompted for the new text, up to a maximum of 29 characters. When you have entered the new text, press RETURN. The text you have just entered will appear next to that relay.

A-H. Pressing each of these letters toggles the appropriate relay on or off. You will see the colour of the letter alter as you press the key. Red means that relay is off, Yellow means it is on.

3 - Audio switcher control. This will allow control of an eight input, two channel audio switcher, yet to appear in CQ-TV.

4 - Vision switcher control. This allows control of the eight input, two channel vision switcher. When selected, you are presented with another menu, and the following options:

1 - Return to previous menu. This option takes you back to the previous menu

2 - Redefine inputs. This option allows you to give each input a unique label. See the description above, for the relay card.

A-H. These are the letters corresponding to the first channel. The letter ‘A’ is input 1, ‘B’ is input 2, etc. To select input 4 to this channel, press the letter ‘D’ Input 4 will now be connected to the first channel.

I-P These are the letters for the second channel. They work in exactly the same way. You should see the colour of the letter change as you press it. This indicates the current choice.

5 - External test card control. This option gives computer control to the electronic test card that appeared in the CQ-TV handbook. The options are as follows:

1 - Return to previous menu

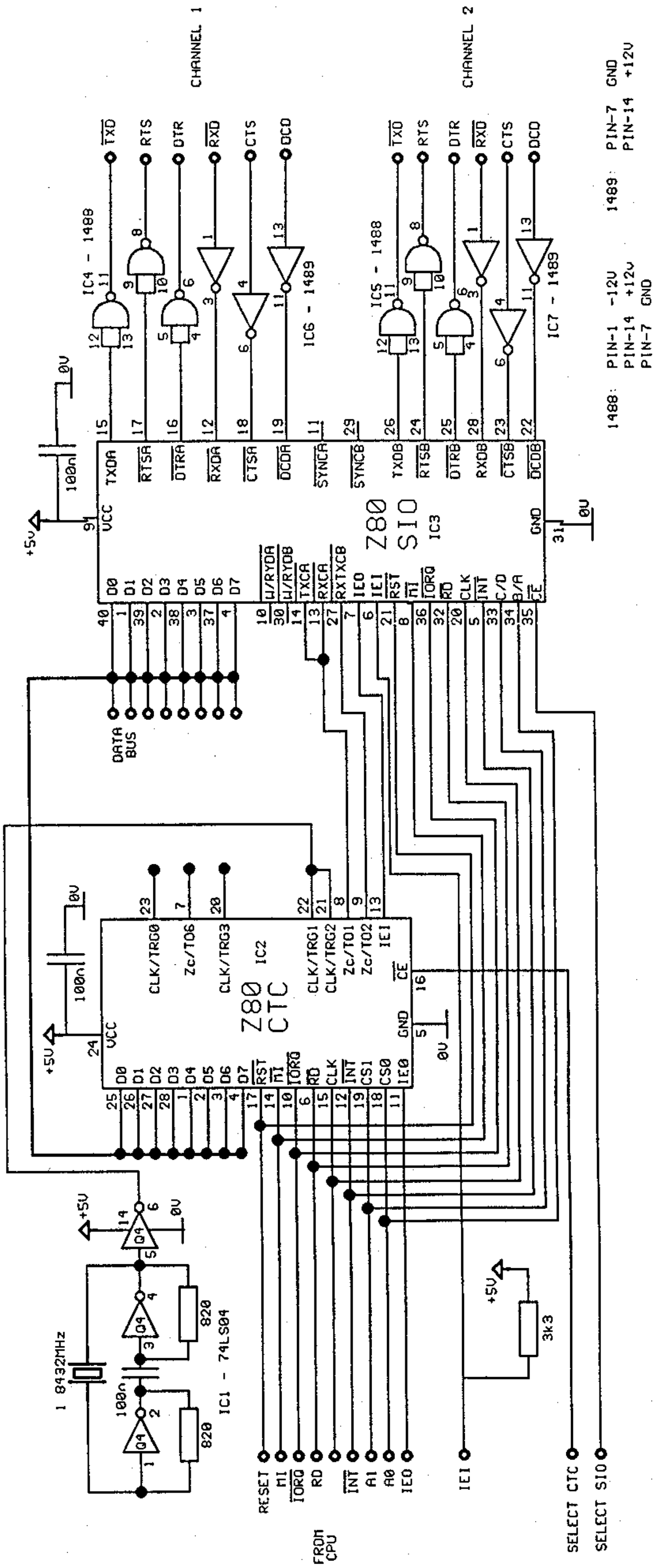


Fig.9: Serial Port Circuit Diagram

A-J These letters allow you to select the pattern you require. They are all labelled on the screen. See the previous I^2C booklet for information on how to connect this option.

If you still require manual control as well, the computer control connections can be wired in parallel with the existing decade switch. Turning the decade switch to the full test card option will allow computer control. Selecting the full test card on TELETRON, or turning TELETRON off, will give manual control.

The Machine Code Monitor Commands

There now follows a detailed description of the machine-code monitor commands:

CALL: This allows you to call a machine code routine held anywhere in the Z80's memory map. Typically, you will enter a routine into RAM and use this command to start running it. The syntax for this command is:

CALL xxxx. Where 'xxxx' is a four digit hexadecimal address. IE: 0000 to FFFF.

Example: CALL 9A00. This command will transfer control to the address at 9A00h.

Tips: If your code keeps the stack tidy, you may return control to TOS by executing a RETurn instruction. The registers are saved on return to TOS and may be examined using the REGISTERS command -see later.

CLS: Perhaps the simplest of the commands, this will clear the screen and return the cursor to the top left hand of the screen. The syntax for this command is:

CLS. There are no parameters.

DATE: This command will display the current date (Providing you have the Real Time Clock chip fitted on the VDU card) and depending on whether you passed any parameters, will either set the date or return the READY prompt. The syntax for this command is:

DATE [dd/mm/yyyy]. Where dd is a two digit date (01-31), mm is a two digit month (01-12) and yyyy is a four digit year (1900 -2999)

The fact that the date is in square brackets means that this is optional and if omitted, the current date will be displayed then you will be returned to the prompt.

Example:DATE 24/11/1990. This will set the current date to 24th November 1990.

DISASSEMBLE: This command will disassemble machine code from the address passed, this part of the system has only just been written and may still contain some bugs, but on the whole it will disassemble machine code in the Z80's memory map quite effectively. To get the prompt back, press ESCape. The syntax for this command is:

DISASSEMBLE xxxx. Where 'xxxx' is a four digit hexadecimal address. IE: 0000 - FFFF.

Example: DISASSEMBLE 0000. This will start disassembling the machine code at 0000h. (The start of the operating system EPROM).

Tips: Try disassembling from address 0000 and follow the code through, the first instruction should be 'DI' then 'IM 1' and 'JMP xxxx' after you see the JMP instruction press ESCAPE and start disassembling from the address after the JMP instruction. This is the start of the operating system itself. Don't look too hard though, you'll see all my bugs !

EXAMINE: This command allows you to dump area's of memory to the screen for examination. This command will display the area of memory you pass it, so if you ask it to display more than one screenful at once, it will do so. The display will scroll when the bottom of the screen is reached. The syntax for this command is:

EXAMINE xxxx yyyy. Where 'xxxx' is a four digit hexadecimal start address and 'yyyy' is a four digit hexadecimal stop address.

Example: EXAMINE 1200 12FF. This will display 256 bytes of data from 1200h to 12FFh (Part of the EPROM) the display is in the following format:

Add Hex data bytes Characters

1200 41 53 43 49 49 20 54 65 ASCII Te

1208 78 74 2E 00 01 02 03 04 xt......

If the data is a valid ASCII character then it will be displayed on the right if the data is not an ASCII character, then a dot will be displayed instead.

Tips: Use this command to look at the text in the EPROM, you never know what you'll find !

FILL: This command fills an area of memory will the value you pass it. The syntax for this command is :

FILL xxxx yyyy zz. Where ‘xxxx’ is a four digit hexadecimal start address, ‘yyyy’ is a four digit stop address and ‘zz’ is a two digit hexadecimal value to fill the memory with.

Example: FILL 9800 9900 AA. This will fill the area of RAM from 9800h to 9900h (256 bytes) with the value AAh.

Tips: Remember you can only alter the contents of RAM, if you try to fill the EPROM nothing will happen. Try to keep away from the areas of RAM between 8000h and 97FFh as this is used by the operating system and altering values in that range can cause the CPU to crash, or produce some strange results.

IN: This command will display the data at a port on the I/O map. The syntax for this command is :

IN xx. Where ‘xx’ is a two digit hexadecimal address.

Example: IN 00. This will input the data at I/O address 00h (Port A of the 8255 chip - What the keyboard is connected to) and display it on the screen.

Tips: Use this command in conjunction with the OUT command to control devices on the CPU’s I/O map. IE: Port B and C of the 8255 can be connected to external devices and these commands will allow you to control them.

DOWNLOAD: This command is used to download data into the CPU’s RAM, at a high rate of knots. It has no parameters. Unless you have a program that will output parallel data in the INTEL HEX format (GB3ET repeater group have such a program) I suggest you don’t bother with this option. I use it to download and test machine code programs compiled on my PC with a cross-assembler, before committing them to EPROM.

I would be happy to supply further information on this command if anyone is interested - G1FEF.

MENU: This command has no parameters and once executed will transfer control back to the menu driven system, leaving TOS.

MODIFY: This command allows you to modify data in the CPU’s RAM. Data at the current address is displayed, you may then alter it or scroll forwards or backwards through the memory map.

The syntax for this command is:

MODIFY xxxx. Where ‘xxxx’ is a four digit hexadecimal start address.

Example: MODIFY 9800. This will display the contents of RAM at address 9800h and allow you to alter it, or move forwards or backwards through memory, one byte at a time. The above command will produce a display something like this:

9800 00. The ‘9800’ is the current address, the ‘00’ is the contents of RAM at that address (this will vary), the ’.’ means the data byte is not an ASCII character (If it was an ASCII character, it would be displayed), finally the ‘_’ is the cursor and is waiting for you to enter some data. At this point you have four options,

1) Enter new data as a two digit hexadecimal byte.

2) Press the ‘full stop’ key - This will take you back to the command line

3) Press the ‘PLUS’ key - This will move to the next address, without altering the contents of memory.

4) Press the ‘MINUS’ key - This will move to the previous address, without altering the contents of memory.

Tips: Use this command to enter machine code programs that you write. Then execute them with the CALL command.

OUT: This command is the opposite of the IN command and allows you to output data to the CPU’s I/O ports. The syntax for this command is:

OUT xx,yy. Where ‘xx’ is a two digit hexadecimal address and ‘yy’ is a two digit hexadecimal data byte.

Example: OUT 01,55. This will output the value 55h to port 01h (Port B of the 8255 chip).

REGISTERS: This command will display the contents of the CPU’s registers, as they were on return from the CALL command. If you have not used the CALL command yet, the displayed values will all be zero. The syntax for this command is:

REGISTERS. This will produce a display on the screen as follows:

HL DE BC 0000 0000 0000

IX IY AF 0000 0000 0000

Meaning that the contents of all registers were zero (Usually only seen when the CAll command has not been used yet).

Tips: See the memory map at the end of this document and locate the address of the RAM where these values are held. If you then use the MODIFY command to alter them, when you next use the CALL command, the registers will be set to the values you have entered BEFORE your routine is called.

SEARCH: This command allows you to search through the entire memory map for a particular sequence of hexadecimal bytes, or for a particular sequence of ASCII characters. The syntax for this command is:

SEARCH xxxx yyyy aa bb cc. Where 'xxxx' is a four digit hexadecimal start address, 'yyyy' is a four digit hexadecimal stop address and 'aa' 'bb' 'cc' are two digit hexadecimal data bytes.

or:

SEARCH xxxx yyyy ''STRING''. Where 'xxxx' is a four digit hexadecimal start address, 'yyyy' is a four digit hexadecimal stop address and STRING is a string up to 80 characters long of ASCII characters, enclosed in double quotes.

Examples: SEARCH 9000 FFFF 55 AA. This will search for the sequence 55h AAh in memory from 9000h to FFFFh

2) SEARCH 0000 7FFF ''BATC''. This will search for the string ''BATC'' in memory from 0000h to 7FFFh

If the search is successful, the message 'Match found at xxxx' will be displayed, where xxxx is a four digit hexadecimal address corresponding to the address at which the search succeeded.

If the search was not successful, the message 'No match found' will be displayed.

TIME: This command works in the same manner as the DATE command, but allows you to display and alter the time. The syntax for this command is:

TIME [hh:mm:ss]. Where 'hh' is a two digit decimal number depicting the hours, 'mm' is the minutes and 'ss' is the seconds.

Example: TIME 19:55:00. This will set the time to 'five to eight pm'. If you omit the parameters, the current time will be displayed, you will then be returned to the prompt.

Memory Map

Address	Description
0000	Start of EPROM containing the code to run the CPU board.
7FFF	End of the EPROM. It is 32K bytes long, not all of it is used.
8000	Start of RAM
9FFF	End of RAM if only 8K is fitted
FFFF	End of RAM if the full 32K is fitted.

Within the first *4.5K* of RAM are the variables used by the operating system, these can be safely looked at with the EXAMINE command, however it is not advisable to alter any of them, apart from the area used to store the registers before using the CALL command. For completeness the locations used are as follows:

8000	Two byte temporary storage
8002	Length and frequency of the beep
8004	Copy of the contents of the 8255 control register
8005	Maximum length of string input

The following locations are those used to hold the register values:

8006	AF Register
8008	HL Register pair
800A	DE Register pair

The following locations are variable used to control the PC bus:

801E	Teletext chip register 1 RAM copy
801F	register 2
8020	register 3
8021	register 4
8022	register 5
8023	register 6
8024	register 7
8025	register 8
8026	Page zero row position (For the cursor)
8027	column
8028	Page one row
8029	column
802A	Page two row
802B	column
802C	Page three row
802D	column
802E	Page four row
802F	column
8030	Page five row
8031	column
8032	Page six row
8033	column
8034	Page seven row
8035	column
8036	Keyboard buffer start address
8038	Keyboard buffer end address
8078	Vector for NT
807A	Vector for NMI

800C	BC Register pair
800E	IX Register
8010	IY Register
8012	RAMTOP Variable, holds the current top of RAM
8014	FLAGS Holds various system flags
8018	Flash rate for cursor
801A	Temporary storage for interrupt routines
801C	Cursor row
801D	Cursor column
9000	4 pages of checksum protected RAM
9000	Video switcher NVRAM space
9100	Relay card NVRAM space
9400	Teletext and Teletype ‘save’ area
9800	From here on up, is clear for user applications.

LNPUT/OUTPUT MAP

The I/O map has only two devices connected to it (at the moment !) and there is plenty of free space to add your own devices, i.e:

* Speech synthesisers

807C	Vector for error handler routine
807E	Vector to error table
8080	12C message buffer (1K Bytes long)
8480	String input buffer (7Th bytes long)
8500	Disassembler workspace
8500	Teletext acquisition buffer
8600	Operating system buffer
8A00	Real Time Clock buffer
8B00	Keyboard buffer
8B80	Machine stack, up to 8FFF

* Music synthesizers.
* Control ports to switch other items of equipment on and off

* Input ports to monitor activity in the outside world.
* Printer ports.
* Serial ports.

.the list is endless.

The address’s used so far are:

00	Port A of the *8255* chip
01	Port B 02 Port C
03	Control port for the 8255 chip
60	PC I/O Port

A Simple Test Program

Here is a short Z80 machine- code program for you to type in and try, just follow the instructions listed below:

Exit to TOS by selecting Option-1 from the main menu, then type in:

MODIFY 9800 followed by RETURN (or ENTER). Type in the following Hex. digits exactly as they appear:

CD 45 17 0C 05 00 3E 0E 32 1C 80 3E OF 32 1D 80

CD B1 14 CD 7F 18 3E 0A 32 1C 80 3E 10 32 1D 80

CD B1 14 CD 24 18 D7 30 DD CD 45 17 04 0C 00 C9

After entering the last set of Hex digits (C9) enter a full stop. This will take you back to the prompt. You can then run the program by entering:

CALL 9800 followed by RETURN (or ENTER).

If anyone would like the source code for this program then send an SAE to Chris Smith G1FEF, 107 Hitchin Street, Biggleswade, Bedfordshire, SG18 8BL.

Keyboard Problems

If you have a PC in the shack then you can connect its parallel or Centronics output direct to the I^2C projects keyboard input with no hardware other than the connecting lead. This removes the need for dual keyboards in the shack and in addition allows the down load of Intel Object Code Format direct to the I^2C computer.

All you need is the software for the PC which is now available at a cost of £10 including post and packing, from The GB3ET repeater group care of:

Trevor Brown, 14 Stairfoot Close, Adel, Leeds LS16 8JR.

The software comes complete with any necessary documentation and instructions. Please state which floppy disc format you require.

All proceeds go to maintaining and improving GB3ET

A Spectrum Computer Controlled ATV Repeater

ATV repeaters are growing in popularity, they enable some contacts to be made that would otherwise not be possible because of difficulties imposed by terrain. They often represent an ideal ATV meeting place, where ideas and problems can be aired. The latest generation also provide useful electronic news and weather information. The following chapter will enable you to put together a simple ATV repeater.

The basic logic uses a Sinclair Spectrum. This is a very simple repeater logic, but never the less a fully functional one that would enable a new repeater license holder to get the necessary hardware on the air quickly. It would make an excellent backup for more advanced repeaters that could be quickly pressed into service when its logic was being updated or repaired, or it may just be useful to play with and gain experience before designing your own repeater logic.

The Sinclair Spectrum has been chosen because they were produced in very large quantities and have now been replaced, in most homes, by a more advanced generation of computers, and as such are readily available on the second hand market at some very attractive prices.

The Spectrum needs first to be modified to provide a composite video output as described in chapter-4 pages 37 and 39. The 24cm receiver and transmitter are shown as block diagrams, you can choose your design from the chapter-6. The transmitter needs its 75 ohm input termination removing and the receiver needs a filter in the aerial lead to stop the repeater’s transmitter desensitising it. This filter need not be too complex in design and its rejection will it depend on the placing of the two aerials with respect to each other and the transmitter power. In the UK with nearly 70MHz between input and output (RMT 2) some repeaters have been known to work without the filter and achieve the full legal power of 25 watts ERP and suffer no desensitising.

The circuit diagram of the controller is shown in Fig.1 The logic uses only four integrated circuits and can be put together in a single evening. The connections to the Spectrum edge connector are via the appropriate socket that fits the PCB connector situated on the rear of the computer. The +5 volt supply can be taken from the computer as there is sufficient reserve for add-ons such as RS232 interfaces and micro drives, in their absence three low-power Schottky packages and an NE567 will not overload the internal 5 volt regulator. The +12 for the relay will depend very much on the choice of relay, but in general small signal switching types can be driven from the output of the Spectrum power pack. The switching between beacon mode, where the Spectrum test card (or whatever) screen is displayed, and the repeat mode, where the incoming TV signal is passed to the transmitter, is done with a humble relay, for the sake of simplicity. You can always add bells and whistles to your repeater later, but here we have concentrated on simplicity.

The Spectrum needs to be aware of the fact that someone is trying to access the repeater. This is accomplished by looking at the video output of the receiver and deciding when a video signal is present. This is achieved by TR1 which is a sync separator. It is biased in such a way that it only conducts on the negative excursions of the composite TV waveform. The waveform on the collector of TR1 has inverted sync pulses and little or no video present. This waveform is passed to the NE567 tone decoder via a small 560 pF capacitor. The free run oscillator of this decoder is set to 15.625kHz in the UK (625 TV line speed) by adjusting RV1. When the NE567 receives pulses of the correct frequency it will present a logic 0 on pin-8.

The computer software is such that it is constantly pulsing A7, IORQ and RD low. This enables the gates and routes pin-8 of the NE567 through to bit-7 of the computer’s data bus. If the tone decoder is locked then a logic 0 will switch the diode on and put a logic 0 on bit-7 of the data bus low. The software will respond to this logic 0 in the manner shown by the flow chart in Fig.2.

To switch the repeat/beacon relay the Spectrum will send out a logic 0 on A7 along with IORQ and this time WR. Data bit-0 will be set to logic 1. This high is latched in the 74LS175 latch and as such will turn on TR2 and energise the repeat/beacon relay so that the repeater goes into the repeat mode.

The software will now monitor the tone decoder to ensure that the incoming video remains and will also monitor the duration of the over. If the video disappears then it will release the relay and drop back into beacon mode and send a ‘K’, both on the screen and via the computers audio channel in CW. If a response from the tone decoder is not forthcoming, indicating the continued absence of video, then the computer will respond by displaying its call sign screen and sending out its callsign in CW. If the incoming signal times out, rather than drops out, the repeater will drop to beacon mode, identify itself both via the computers screen and its audio channel, and resume relay mode. When the repeater is running in beacon mode it will also periodically identify itself to comply with UK licensing rules.

Provision has not been made on the logic for turning the transmitter on and off, as all UK 24cm ATV repeaters radiate a continuous video signal, either repeated video in the relay mode, or an electronic test card and ident in the beacon mode, so that they can be used as beacons for aligning and testing 24cm ATV equipment.

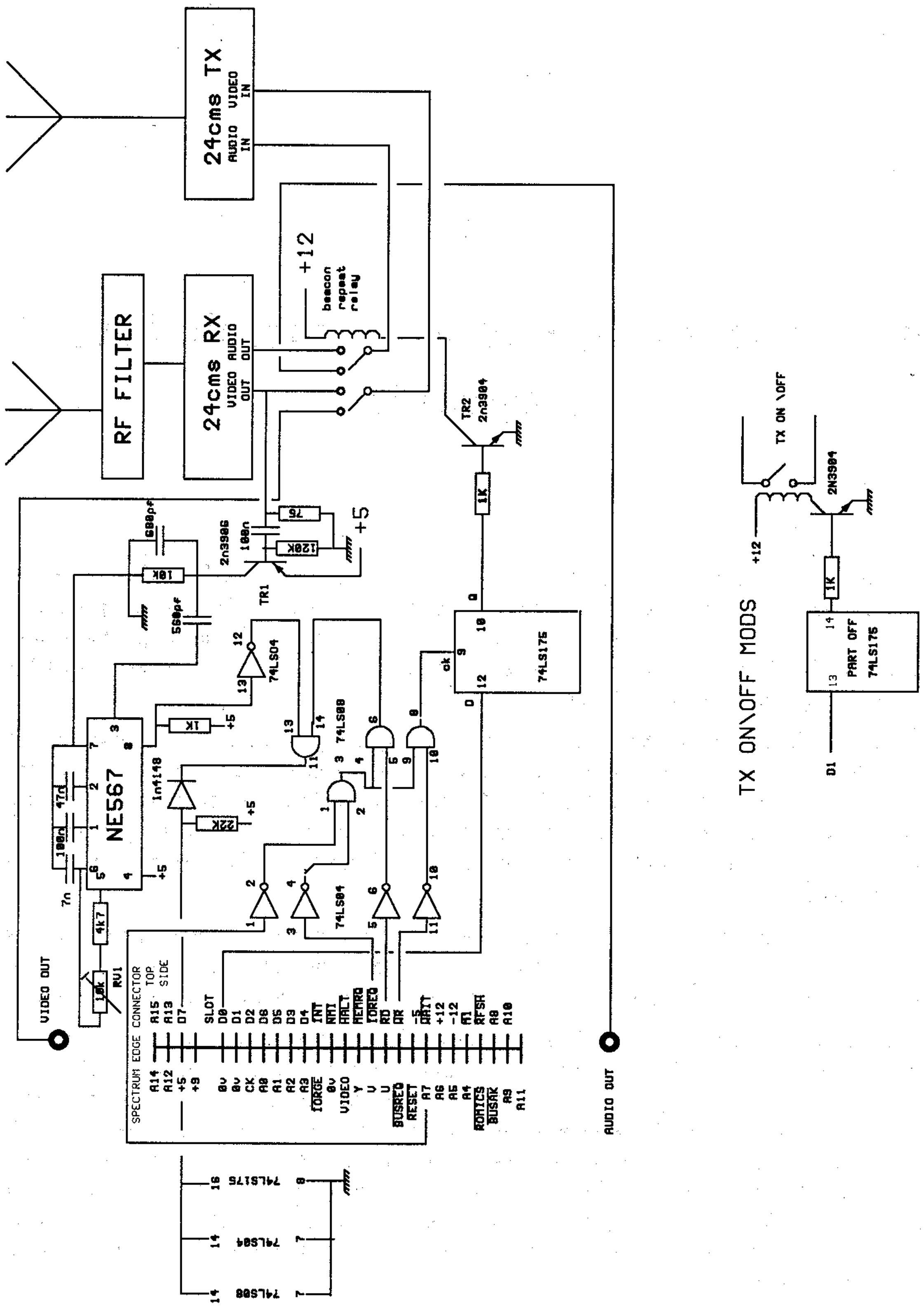


Fig.1: The Spectrum Computer ATV Repeater Controller

If you are building a repeater outside the UK and need the ability to switch the transmitter on and off as well, then data bit-1 on the Spectrum edge connector needs connecting to pin-13 on the 74LS175 and pin-14 needs connecting to a relay via a resistor and transistor, in the same way that TR2 is connected (see Fig.1). This extra relay can then be software controlled to switch the transmitter on and off, by the BASIC command ‘OUT 127,2’ to pull the relay in and ‘OUT 127,0’, which will let both the transmit on/off relay and the beacon/repeat relay drop out. The logic is arranged so that the repeater is in the beacon mode whenever the beacon/repeat relay is not energised.

The software that controls this repeater logic has all been written in BASIC, so that it can easily be customized to suit your repeater. This is not the ideal way of doing it and the Morse ident is a little slow as a result. A better way is to use Z80 machine code, but that is something that would require more space to cover than is available here.

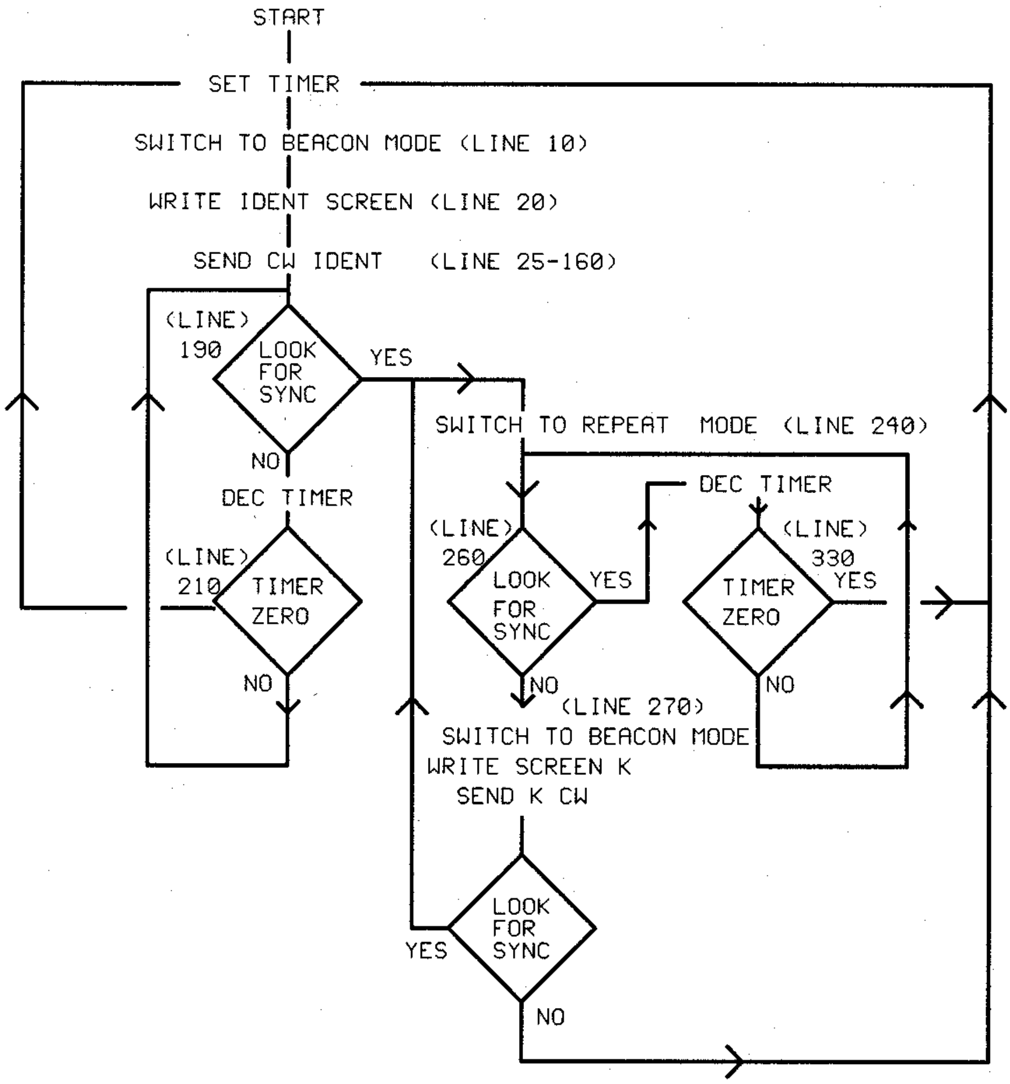


Fig.2: The Software Flow Chart

The screens and Morse ident have been initially set to GB3ET. The two print statements at lines-20 and 280 should be replaced with print statements using the large block graphics that are available on this computer, to enable them to be seen in under less than ideal viewing conditions.

Fig.2 shows the software flow chart. ‘SET TIMER’ is a number loaded into a software variable that is reduced by ‘‘DEC TIMER” when it is zero. The repeater will give a periodic ident in beacon mode or will time out and send sound and vision idents when in repeat mode. This number can be adjusted to suit your own requirements.

Fig.3 shows the basic listing, and in an effort to tie the two together I have put some of the line numbers from the listing in Fig.3 onto the flow chart in Fig.2. I am sure that once you have got the basic system running it will expand in both hardware and software.

Controls to set both the audio and video levels in both repeat and beacon mode should be one of the first additions. A video filter to clean up the output of the Spectrum,s video before you inflict it on the airways, and some kind of watchdog that ensures if the computer crashes it will revert to beacon mode should be amongst the first additions.

If nothing else this simple logic will provide an insight into computer programming and the experience of computer controlling TV hardware. The more advanced approach to repeater logic is to use the I^2C modules that are explained in chapter-7 of this book.

```
5       LET a = 240: REM SET TIMER
10      OUT 127,0 : REM BEACON MODE
20      PRINT AT 10,10 ‘‘GB3ET”
25      REM CW IDENT
30      BEEP .4,6:PAUSE 10
40      BEEP .4,6:PAUSE 10
50      BEEP .1,6:PAUSE 50
60      BEEP .4,6:PAUSE 10
70      BEEP .1,6:PAUSE 10
80      BEEP .1,6:PAUSE 10
90      BEEP .1,6:PAUSE 50
100     BEEP .1,6:PAUSE 10
110     BEEP .1,6:PAUSE 10
120     BEEP .1,6:PAUSE 10
130     BEEP .4,6:PAUSE 10
140     BEEP .4,6:PAUSE 50
150     BEEP .1,6:PAUSE 50
160     BEEP .4,6;PAUSE 100
190     REM LOOK FOR SYNC
200     LET b=IN 127: IF b<=127 THEN GO TO 240
210     LET a=a-1: IF a=0 THEN GO TO 5 :REM DEC TIMER IDENT IF ZERO
220     PAUSE 50: GO TO 190
240     REM REPEAT MODE
250     OUT 127,1:
260     LET b=IN 127: IF b<=127 THEN GO TO 330
270     OUT 127,0:REM BEACON MODE
280     PRINT AT 10,10; ‘‘K”
290     BEEP .4,6 PAUSE 10: REM CW K
300     BEEP .1,6 PAUSE 10
310     BEEP .4,6 PAUSE 100
320     LET b=IN 127: IF b<=127 THEN GO TO 240
330     REM DEC TIMER
340     LET a=a-1 IF a=0 THEN GO TO 5
350     PAUSE 50: GO TO 240
```

Fig.3: The BASIC Software Listing

Operating an Amateur Television Station

Operating ATV

Although operating an amateur television station live on the air is basically the same as with any other mode, there are two quite distinct differences.

Firstly, in the case of the 70cm band you are actually working two bands at once; 70cm for the video link and probably 2M for the talk-back link.

Secondly, in the case of the 24cm band you will most likely be working full duplex cross-band, with the ATV station's audio on the 24cm sub-carrier and the receiving station on 2M, or wherever; plus, you may also be working the 2M (or wherever) talk-back link to other stations, especially when working through repeaters.

These differences, the fact that invariably you will be working two bands at once, should always be remembered. Apart from some of the embarrassments that may occur (remember, you may be on camera live -don't do anything you wouldn't do in public!) you should be more aware than when working normal phone operating, that other stations also use our crowded bands, particularly 70cm. Do not go spraying huge amounts of video power when it is not necessary. When working local stations, reduce your video output power to all that is necessary for the receiving station to get a P5 (broadcast quality) picture, if indeed they can. This is just as pertinent on 24cm when working local repeaters.

The method of giving signal reports also differs with ATV. As you read in the last paragraph, we use a 'P' system for reporting signal strength. The chart reproduced on the following page shows the basis for the reporting system. Whilst this is a good guide for ATV on 70cm, which is (or should be!) monochrome, on 24cm more often than not colour pictures are transmitted. Thus, the noise levels shown on the reporting chart have to be mentally modified to allow for sensible signal reports when colour noise is present on the received signal.

The reporting of signal strengths with colour pictures can be a tricky business. The Author's own personal method is to turn the colour off on the receiving monitor or television, and then give a 'P' report on the monochrome signal. Then, the colour is turned back up and a modified chrominance noise report given. This may give the sending station a better idea of how well the transmitting system is operating, as you require many more dB's of received signal to give noise-free colour signal than you do for a monochrome one. Also, such problems as Triangular Noise and Chrominance Noise are added to the signal by the demodulation circuits, which are not visible when receiving monochrome. Picture reporting is more a science of feel rather than one of fact!

Amateur Television Repeaters

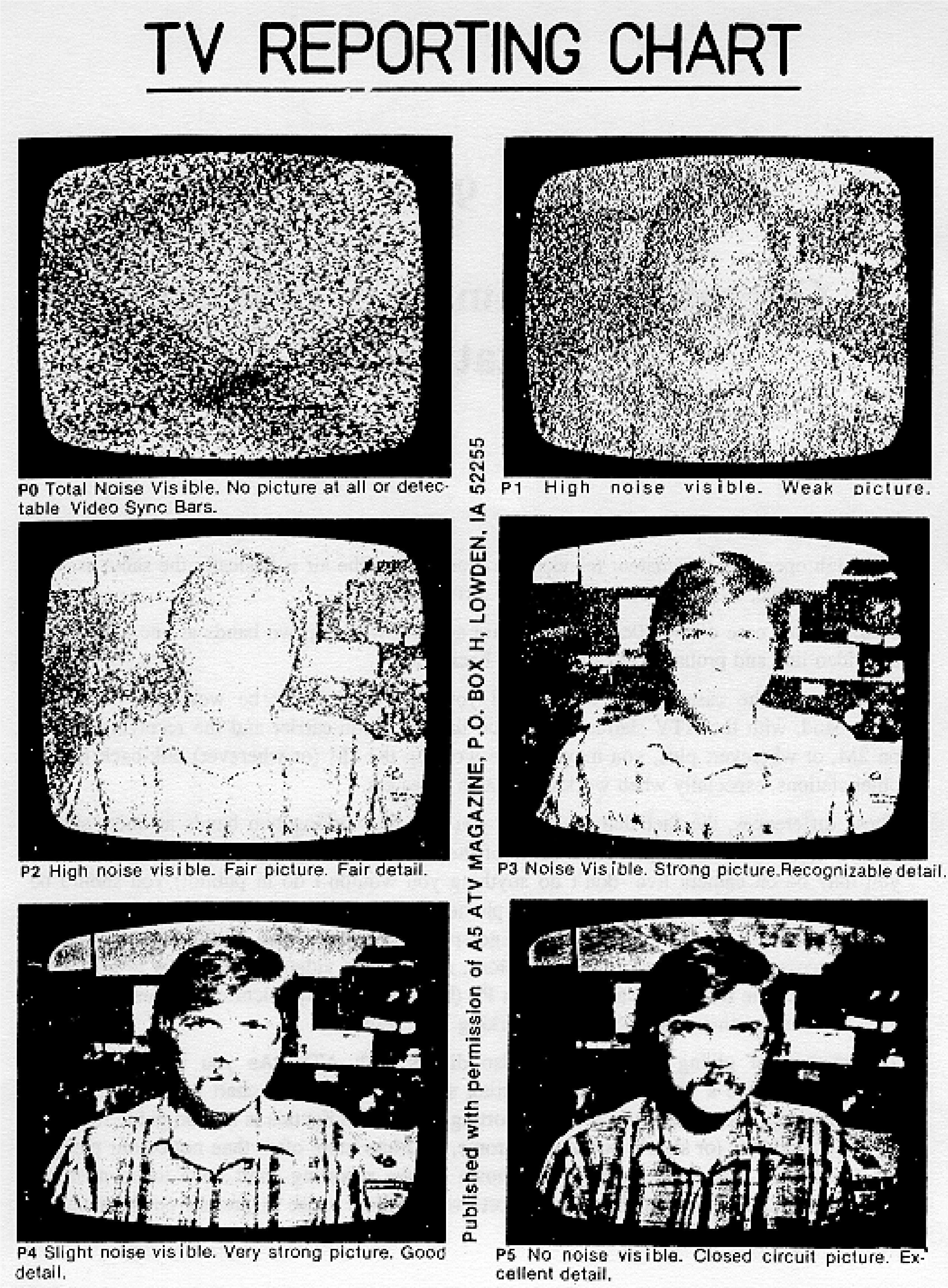
At the time of writing this book there are some eighteen amateur television 24cm FM repeaters operational in the UK, with one AM repeater. The input frequency of most of the FM ATV repeaters is 1249MHz and the output frequency of most is 1316 MHz (see Appendix C). The ATV repeaters run their transmitters continuously with test cards and news messages being displayed when no input is present. GB3ZZ in Bristol takes this a little bit further and radiates among other things satellite weather pictures when no input is present. The range of these repeaters is some 30 miles as they are restricted to 25 watts ERP in common with the sound repeaters, only on 24cm this does not carry as far especially when you spread it over 12 to 15MHz as is the case with FM ATV.

GB3ET is situated at the top of the Emley Moor TV mast (900ft) and so is often worked by stations beyond 30 miles indeed in the summer of 1991 it was seen in Hamburg. Stations have often got into GB3ET with power levels of as little as 10 milliwatts, which can be realised with a single self oscillating PA stage, comprised of a single BFR91 and composite video being applied direct to the Varicap diode that FM modulates the BFR 91. When you realise this level of crude engineering may put your pictures through an ATV repeater and out into Hamburg then you start to appreciate the power of ATV repeaters.

On the receive side, redundant satellite receivers are often pushed into service. If you remove the LNB then you have a receiver that tuned 900 to 1750MHz. Before you connect a 24cm Yagi in place of the LNB a word of warning, the coax to the LNB carries signals from the LNB to the receiver and DC power to the LNB, 24cm aerials often present a DC short circuit to the coax that will result in damage to the receiver. The fixes for this are three fold:-

1) find the DC inside the receiver and disconnect it

2) use an aerial that is not a DC short circuit such as the Sandpiper helical



3) Use the DC to power a Mast head preamplifier. Most satellite receivers are deaf without the high gain LNB so this is by far the most elegant fix.

The last point on satellite receivers is that ATV stations use less deviation than satellite systems, so the resultant video signal will be lower level and may need tweaking up. There are often potentiometers inside the receiver, but if all else fails you can resort to an external video amplifier.

Aerials and ATV repeaters can be a problem in that the bandwidth necessary for a single loop Yagi to work on both the input frequency and output frequency, without compromising its gain, can be a problem. The fix employed by many is to use two separate aerials, one for receive and on for transmit. This avoids the need for change over relays, and with the wide separation between repeater input and outputs you can often look through the repeater and see yourself coming back which can be very useful.

ATV repeaters are all very simple to access, they do not require tones like their audio counterparts, all they require is a video signal on the input frequency, which must be a valid CCIR PAL television signal, which will then be re-transmitted at the output.

Remember, whenever an ATV repeater is not being accessed by a television signal then it automatically switches to the beacon mode. Thus, there is always a picture being radiated and often sound (be it Morse code ident, a tone, or whatever) on the audio subcarrier.

ATV Contest Working

Finally, a few words concerning ATV contests. The BATC runs several contests throughout the year, details of which are found in CQ-TV, European ATV societies also run ATV contests, many of which coincide with BATC ones. There is also an International ATV contest which is entered by all the member countries of Europe.

When working contests different operating practices should be used and these are laid out in the BATC contest rules, which are included in Appendix E. In general ATV contests are much more friendly than HF ones. Stations will have more time for you and a few pictures and a little chat will always be exchanged along with the essential details. Do not be afraid to contact a contest station he will welcome the contact.

One word of warning, ATV channels are wide and space is at a premium, so do not radiate endless test cards in the hope of raising some one. The calling frequency on 144.750MHz is also in demand, when you have raised someone please QSY and leave 144.750 free for others.

If you are operating on 70cm a good video filter should be used to reduce the video bandwidth which can often be limited to 2MHz for contest working.

We hope that you have as much fun with Amateur Television and look forward to either meeting you on the bands or in person at one of the BATCs Conventions.

Good Luck from Mike Wooding G6IQM and Trevor Brown G8CJS

Appendix A

UK 625 Line PAL system I specification

Number of lines per picture	625
Interlace	2 to 1
Aspect ratio	4 to 3
Line frequency	15.625kHz
Field frequency	50Hz
Colour subcarrier frequency	4.43361875MHz
Video bandwidth	5.5MHz
Sound subcarrier frequency	5.9996MHz
Channel bandwidth	8MHz
Upper sideband width	5.5MHz
Lower sideband width	1.25MHz
Vision carrier modulation	Amplitude (AM)
Sound carrier modulation	Frequency (FM)
Modulation sense	Negative (95% amp. = sync)

Appendix B

The Amateur Television Sections of the UK Band Plan

Band	Frequency	Mode	Use
3cm	10.200GHz	FM FSTV	RT101 repeater input (UK)
	10.040GHz	FM FSTV	RT101 repeater output (UK)
	10.255GHz	FM FSTV	RT102 repeater input (UK)
	10.150GHz	FM FSTV	RT102 repeater output (UK)
	10.250GHz	FM FSTV	RT103 repeater input (UK)
	10.150GHz	FM FSTV	RT103 repeater output (UK)
	10.250GHz	FM/AM FSTV	ATV simplex
13cm	2,330.0MHz	FM/AM FSTV	ATV simplex (proposed)
24cm	1276.50MHz	AM FSTV	RT1 repeater input (UK)
	1311.50MHz	AM FSTV	RT1 repeater output (UK)
	1249.00MHz	FM FSTV	RT2 repeater input (UK)
	1318.50MHz	FM FSTV	RT2 repeater output (UK)
	1249.00MHz	FM FSTV	RT2R repeater input (UK)
	1316.00MHz	FM FSTV	RT2R repeater output (UK)
	1255.00MHz	AM/FM FSTV	European ATV simplex
70cm	434-440MHz	AM FSTV	ATV simplex (higher frequencies preferred)
2M	144.750MHz	FM/SSB	ATV calling
	144.170MHz	SSB	Alt. European ATV talk-back
	144.500MHz	SSTV	SSTV working
10M	28.680MHz	SSTV	SSTV working
15M	21.340MHz	SSTV	SSTV working
20M	14.230MHz	SSTV	SSTV working
40M	7.040MHz	SSTV	SSTV working
80M	3.740MHz	SSTV	SSTV working

Appendix C

UK Amateur Television Repeaters (as of March 1992)

Call	Chan	Location	Status	Manager
GB3CT	RT2	CRAWLEY	OPERATIONAL	G4ZPP
GB3ET	RTS	EMLEY MOOR	OPERATIONAL	G8CJS
GB3GT	RT2	GLASGOW	OPERATIONAL	GM3SAN
GB3GV	RT2	LEICESTER	OPERATIONAL	G0CND
GB3HV	RT3	HIGH WYCOMBE	OPERATIONAL	G4CRJ
GB3LO	RT2R	LOWESTOFT	OPERATIONAL	G4TAD
GB3NV	RT2	NOTTINGHAM	OPERATIONAL	G6YKC
GB3PV	RT2	CAMBRIDGE	OPERATIONAL	G4MDC
GB3RT	RT2	COVENTRY	OPERATIONAL	G6WLM
GB3TG	RT103	MILTON KEYNES	OPERATIONAL	G4NJU
GB3TN	RT2R	FAKENHAM	OPERATIONAL	G4WVU
GB3TT	RT2R	CHESTERFIELD	OPERATIONAL	G4EKD
GB3TV	RT2	DUNSTABLE	OPERATIONAL	G4CPE
GB3UD	RT2	STOKE ON TRENT	OPERATIONAL	G8KUZ
GB3UT	RT1	BATH	NON-OPERATIONAL	G8CPF
GB3VI	RT?	HASTINGS	NON-OPERATIONAL PENDING CHANGE TO FM	G4BCO
GB3VR	RT2	WORTHING	OPERATIONAL	G4WTV
GB3XT	RT103	BURTON ON TRENT	OPERATIONAL	G8OZP
GB3ZZ	RT2	BRISTOL	OPERATIONAL	G8PVG

NOTE: GB3TG is a cross-band repeater linked with GB3TV

Plans are under way for repeaters in the following areas:

East Kent; East Sussex; Goole; Northampton; Central Birmingham; Dorset

Repeater Channel Frequencies

Channel	Input Freq	Output Freq	Mode
RT1	1276 MHz	1311.5 MHz	AM
RT2	1249 MHz	1318.5 MHz	FM
RT2R	1249 MHz	1316 MHz	FM
RT3	1248 MHz	1308 MHz	FM
RT101	10200 MHz	10040 MHz	FM
RT102	10255 MHz	10150 MHz	FM
RT103	10250 MHz	10150 MHz	FM

Appendix D

BATC recommended Suppliers

Bonex Ltd., 12 Elder Way, Langley Business Park, Slough, Buckinghamshire, SL3 6EP. Tel: 0753 49502

Electrovalue Ltd., 28 St.Judes Road, Englefield Green, Egham, Surrey, TW20 0HB. Tel: 0784 433603

Grandata Ltd., KP House, Unit 15, Pop-In Commercial centre, Southway, Wembley, Middelesex. Tel: 081 900 2329

Maplin Electronics, P.O. Box 3, Rayleigh, Essex, SS6 2BR. Tel: 0702 552911

Piper Communications, 4 Severn Road, Chilton, Didcot, Oxfordshire, OX11 0PW. Tel: 0235 834328

RS Components/Electromail, P.O. Box 33, Corby, Northamptonshire, NN17 9EL. Tel: 0536 204555

Farnell Electronic Components, Canal Road, Leeds.

Sendz Components, 63 Bishopsteignton, Shoeburyness, Essex, SS3 8AF.

Video Orderline, 565 Kingston Road, London, SW20 8SA. Tel: 071 542 1171

Jaybeam Limited, Moulton Park Industrial Estate, Northampton, NN3 1QQ. Tel: 0604 46611

Sandpiper Communications, 40 Trehafod Road, Trehafod, Nr.Pontypridd, Mid Glamorgan, Wales. Tel: 0443 685515 or 0685 870425

JVL, Mr.M.H.Walters, 26 Fernhurst Close, Hayling Island, Hampshire, PO11 0DT.

MET, A.Kelly Electronics & Communications, 3 Stoke Road, Aston Fields, Bromsgrove, Worcestershire, B60 3EQ. Tel: 0527 79556

Mainline Electronics, P.O. Box 235, Leicester, LE2 9SH. Tel: 0533 777648

Anzac, 822 Yeovil Road, Slough, Berkshire, SL1 4JA

Appendix E

The BATC Amateur Television Contest Rules

1) Eligibility ... Contests are open to all licenced radio amateurs who are equipped to transmit and/or receive pictures by Fast Scan . Non transmitting amateurs and SWL‘s can also take part with their own section.

2) Dates and Times ... As published in CQ-TV.

3) Location ... Operation must be within the terms of the licence, from either the main station as listed in the current RSGB Call-Book or Portable.

4) Frequencies ... Within the allocated segments of the 70cm, 24cm, 13CM, 3CM and 1.5CM bands. Operation via repeaters does not constitute a valid contest contact.

5) Power ... Output power must not exceed that set out in the terms of your licence.

6) Exchange ... Call sign and a four-figure code number must be conveyed via video. Confirmation of reception by transmitting back the sum of the code numbers on the talk-back channel. **PLEASE NOTE:** all four digits in the contest number should be different and not consecutive. The numbers must be different for each band and each contest. (Any difficulty in this please contact the BATC Contest Manager).

7) Score ... 1 point per kilometre one way. Multiply by 2 for a 2 way. **PLEASE NOTE:** your computer program should give 6371.290982km as the earth‘s radius and 111.2036km for each degree change in latitude before rounding off.

8) Logs ... Separate log sheets should be submitted for each band worked. Each sheet should indicate: Band, Date, Time in GMT., Station worked, Report and Serial Numbers exchanged (each contest log for each band should begin at serial number 001). The code number sent by the distant station should also be recorded on the log (but NOT DICTATED on the talk-back channel only the SUM of the figures in it) and the distant station‘s Maidenhead locator.

The operator must sign the log. A contest cover sheet should be submitted indicating the following: Contest title, Call sign used, Location (QTH), Locator (Maidenhead only please), Operator‘s names and call-signs, Points claimed for each band and total for all bands, numb er of contacts on each band, best DX on each band and the Code number used on each band.

The BATC Contest Manager would also like the following information: Aerials - type/gain and height AGL, Transmitter and PA used including output device, Receiver and preamps used, Power at the aerial and estimated ERP, Name & Address and phone number for contact. (This information is to give me something to waffle about when you win).

Cover sheets **MUST** be signed. Logs and cover sheets must be received by the contest manager no later than the third Monday after the contest.

LOG ERRORS:- YOU WILL LOSE POINTS if there any **UNMARKED** Dupes, incorrect call signs, incorrect code numbers, incorrect locators, incorrect reports and serial numbers.

9) Awards ... A certificate will be issued to the winner and runners up (those placed 1st. 2nd. and 3rd.) in each band. A new award will be made on an annual basis. It will be called THE BATC CONTEST CHAMPIONSHIP. There will be portable and fixed station sections. Any entry received for a BATC and/or the INTERNATIONAL contests will automatically enter the Championship.

Scoring for the BATC Championship ONLY will be as follows for 1992. 70CM points stand as is, 24CM points will be multiplied by 2, all bands above 24CM points will be multiplied by 3. The total of all bands is then added together. This will give a contest winner and his/her score will be adjusted to 1000 points and all other stations scores will be pro- rata.

This will be carried forward for all the BATC contests in the year including the International, which will be run under it‘s own IARU rules. Annual Trophies will be presented at the BATC Convention to the leading Portable and Fixed stations. This award will be held for eleven months and must be returned to the contest manager on request. It can not be won outright.

10) Disputes ... The decision of the Contest Manager and/or The BATC Committee is final.

11) Receive Only Section ... Send log sheet giving Callsign/BRS No./Name, Band, Date,Time in GMT, Callsign of station seen, Report on signals seen, Code number seen, Maidenhead locator of receiving and DX station if possible. The Contest Manager will work out your Maidenhead locator if you send him your Ordnance Survey six figure National Grid Reference and the letters for the 100000 metre square in which you live. (U.K. only) The locator of the DX station will if necessary and if possible be abstracted from other logs received. Scoring one point per kilometre.

12) Spirit of The Contest ... Do **NOT** leave your transmission on 70cm any longer than necessary, you will be spoiling the chances of other stations - If you are a portable station giving a few points away don‘t just work your mates in your club, it‘s fair to let other stations work you! Move off the ATV Calling frequency 144.750 MHz as soon as possible. What about using SSB? A lot of contacts are lost under FM. Let low power stations have a go. Made a few contacts? What a bout sending the log in as a check log? Or even better as an entry! Above all have FUN, it‘s only a hobby.

13) Access to Logs ... A new facility. Copies of any log entered for the contest will be available to competitors for the fee of £1.00 for the first band, plus £0.50 for each extra band, payable to BATC

14) Declaration of Interest ... As some of you will know, Clive G8EQZ and I (Richard G4YTV - BATC Contest Manager) take part in BATC Contests. So that we are whiter than white our logs will be counter-checked by another committee member.

15) Contact Address ... For entry forms, log sheets and cover sheets, also any brickbats, bouquets and any other flying missile along with, I hope, the odd useful comment, direct towards:-

RICHARD GUTTRIDGE G4YTV, IVY HOUSE, RISE ROAD, SKIRLAUGH, HULL, NORTH HUMBERSIDE, HU11 5BH, ENGLAND. Tel: 0964 562498.

Appendix F

Printed Circuit Boards:

ARTICLE	CHAP/PAGE	STK No	PRICE
MONOCHROME PATTERN GENERATOR	4/25	63	£ 3.27
FOUR-INPUT VISION SWITCHER	4/25	25	£ .335
PAL/NTSC COLOUR ENCODER	4/29	18	£ 2.27
RAINBOW ELECTRONIC CALLSIGN GENERATOR	4/30		POA
70cm DOWNCONVERTER	5/48		POA
70cm ATV TRANSMITTER	5/58		POA
24cm RECEIVER	6/65		POA
24cm ATV TRANSMITTER	6/71		POA
24cm SOLID STATE POWER AMPLIFIER	6/81		POA
F3YX 24cm ATV SYSTEM	6/84		POA
I^2C VDU	7/97	41	£ 7.85
I^2C CPU	7/104	40	£ 7.85
I^2C VIDEO SWITCHER	7/105	36	£ 7.85

Special Components:

ARTICLE	CHAP/PAGE	STK No	PRICE
MONOCHROME PATTERN GENERATOR	4/25		2.56
25MHz CRYSTAL		8	£ 3.02
FOUR-INPUT VISION SWITCHER	4/25		
TEA5114 IC		67	£ 1.77
FADE-TO-BLACK	4/34		
TEA5114		67	£ 1.77
LM1881N		39	£ 3.27
I^2C VDU	7/97	41	£ 7.85
SAA5231		43	£ 6.77
SAA5243PE		44	£11.77
PCF8583		45	£ 6.27
I^2C VIDEO SWITCHER	7/105		
GX414		37	£ 5.27
LM1881		39	£ 3.27
I^2C RELAY BOARD	7/114		
PCF8574A		38	£ 3.27

Special Components from Trevor Brown

14 STAIRFOOT CLOSE, ADEL, LEEDS, LS16 8JR.

ARTICLE	CHAP/PAGE	STK No	PRICE
RAINBOW ELECTRONIC CALLSIGN GENERATOR	4/30		
PROGRAMMED EPROM IC5			POA
I^2C CPU	7/104		
PROGRAMMED EPROM IC6			POA

£5.00

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